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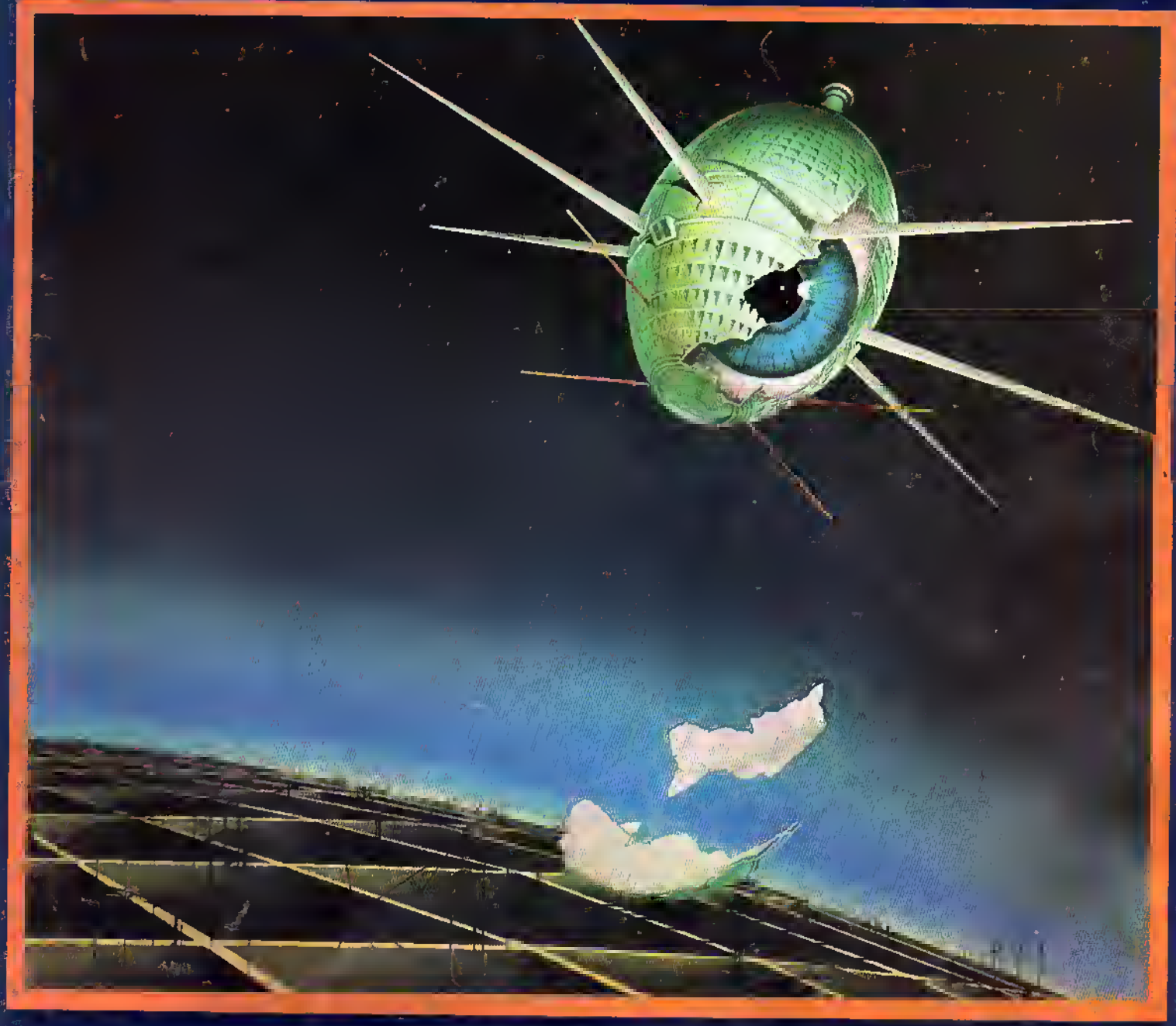

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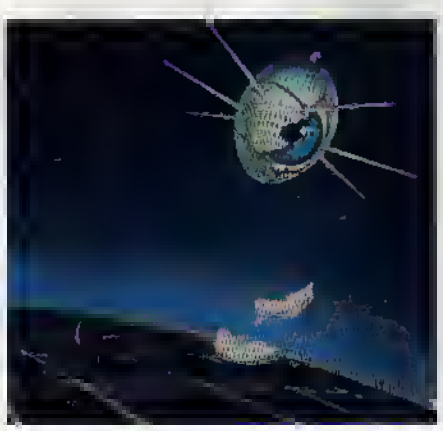
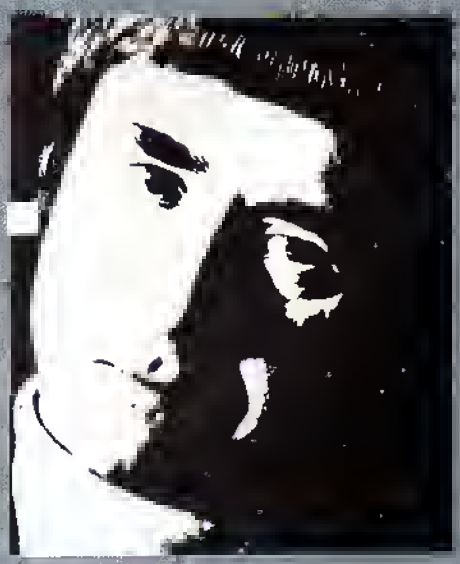
CONTENTS



Cover art for this month's Omni *is a painting entitled* A New Star In Heaven *by German artist Ute Osterwald. Collaborating with her husband, Hans, Ute has seen their art adorn all the major magazines of Europe. Together, they work out of their own design studio in Hamburg.*



FIRST WORD

By Gerard K. O'Neill

"Space resources are too important to be left to the vagaries of national politics."

If you want to be sure something gets done, do it yourself. That's an old rule, and it works. A small band of people from all over the world are applying it now in practice. They feel that the breakout of humankind into space is too important to be left to the vagaries of national politics, and they're making it happen on their own.

With the successes of *Apollo*, *Skylab*, *Soyuz*, *Viking*, and the planetary survey spacecraft, we humans have shown our ability to break free of the limits a planetary surface imposes. Why battle over fossilized energy when out beyond Earth's shadow there streams by every second, wasted, enough continuous solar energy to power our civilization for thousands of years? Why fight over minerals when there's more iron, nickel, aluminum, silicon, and other useful elements in the asteroids than we could obtain by carving away every mountain range on Earth?

NASA conducted technical studies in 1976 and 1977, under my direction, aimed at using nonterrestrial resources. We obtained positive results, since confirmed in year-long contractor studies by Convair/General Dynamics, MIT, and the Lunar and Planetary Institute. If there's a need for big construction in space, whether it's for radio telescopes, deep-space laboratories, solar-power satellites, or space colonies, that need can be met most economically by getting raw materials from the moon or asteroids. That logical result will endure forever because no one can repeal the law of gravity. It will always take more than 20 times as much energy to haul a ton up into orbit from the earth as from the moon.

Despite all good will on the part of our NASA friends, it became clear late in the 1970s that the space agency couldn't carry this research forward without help. Amid reorganizations, continuing governmental budgetary crises, and potshots from critics, NASA was lucky if it could plan even six months ahead. But to get results, research has got to be pushed steadily, and the Space Studies Institute (SSI) was formed in 1977 to do just that. It funds research through tax-deductible gifts from individuals. Overhead? No problem: SSI's founding officers serve without pay. So do its senior advisers, who include both of the last two NASA administrators, other distinguished scientists, and such visionaries as Buckminster Fuller and Barbara Hubbard.

The institute's donors are asked for only $10 to cover the annual subscription, but most of them renew at higher figures. By 1979, hundreds of individuals began pledging larger sums annually for five years. SSI's capital resources, acquired by such voluntary gifts, will never equal the vast sums that governments extract from citizens by taxation, but SSI is building assets that are even more important: continuity and longevity. It is committed to opening the resources of space for human benefit, and it will hold to that commitment no matter what politicians are elected to or defeated in office by the whims of public opinion. Occasionally an administration may abandon a project that SSI started. If so, the institute will turn to the next item on its funding priority list.

SSI funds were allocated first to the construction of a model mass driver, a special type of electric motor that could be used to launch lunar materials to a precise point in space, or to drive space freighters efficiently, running on solar power. The model, built mainly by MIT students working as volunteers, demonstrated an acceleration of 35 gravities: zero to 85 mph in 0.1 second. With continued SSI support, an initial design was drawn up for a second model, to work at 500 gravities of acceleration. NASA became interested and supported its construction. By mid-1980, that machine was working, too.

The institute also began supporting workshops to find the quickest, least expensive method of reaching high economic productivity in space, using solar energy and lunar materials. Specialists in mass-driver design, spacecraft engineering, the chemical separation of lunar materials, and industrial automation cooperated and found that an investment of $6 billion to $8 billion, no more than the cost of wholly private ventures like the Alaska pipeline, would be enough to establish a partially automated industry in space, producing 100,000 tons of products annually, with a value of over $10 billion.

Recently the institute made a third grant, and the research it supported opened the door to what could be the most attractive storehouse of materials in the entire solar system. Following a suggestion by one of SSI's senior advisers, the Nobel laureate Professor Hannes Alfvén, a Princeton graduate student named Scott Dunbar wrote his doctoral thesis on a difficult problem in gravitational theory. He showed that small asteroids could be trapped along the earth's orbit. Those nuggets would be retrievable at almost no cost in energy, and an inexpensive telescopic probe could find them if they exist.

The breakout into space doesn't depend on our being so lucky as to find those particular asteroids, but it does depend on our learning to separate lunar or asteroidal materials into pure metals, silicon, and oxygen. The institute has now put its highest priority on raising funds to build a working pilot plant, at tabletop scale, to extract pure elements from minerals identical to those on the moon. With its constancy of purpose and its independence, SSI is proving that a small amount of money spent wisely can be more effective in advancing a cause than much larger sums scattered for purposes that change with every passing year. **OMNI**

The Space Studies Institute, Box 82, Princeton, NJ 08540, publishes a quarterly newsletter for subscribers ($10 a year).

CONTRIBUTORS

OMNIBUS

GIGER

MAZUR

KING

We were delighted that Swiss artist *H. R. Giger* won the Academy Award for outstanding visual effects in the Twentieth Century-Fox motion picture *Alien*. Though highly visible in European circles since 1967, Giger's art was showcased nationally for the first time in *Omni*. The prizewinning November 1978 cover, a haunting Medusa, is typical of Giger's genius. The artist's talent has since earned him several other merit awards for his *Omni* illustrations that accompanied "Found" (October 1978), "The Ancient Mind at Work" (February 1979), "Galatea Galante" (April 1979), and "Illegal Aliens" (November 1979). "Giger's work," *Omni*'s art director Frank DeVino observed recently, "explores the ideologies and mythologies of the human mind. This requires a special kind of vision."

Giger's is not the only art to win recognition through *Omni*. The Society of Illustrators' awards went to *Ernst Fuchs* for "Invisible Stripes" (October 1978) and *De Es Schwertberger* for "Zen" (October 1978). Fuchs paints in the style of "fantastic realism," a genre that originated in Vienna. Austrian-born Schwertberger has received critical acclaim for the stone figures that characterize his art.

Omni's editorial content has also earned several noteworthy prizes. Science writer *Dennis Overbye* was named the 1980 recipient of the American Institute of Physics journalism award for improving public understanding of physics and astronomy. His prizewinning article "Wizard of Time and Space," a profile of British astronomer *Stephen Hawking*, appeared in our February 1979 issue.

Already the recipient of the 1979 and 1980 Galaxy awards for most outstanding science-fiction publication, *Omni* has just received the Nebula Award for "Sandkings," *George R. R. Martin*'s spine-tingling tale of a pet owner obsessed with "feeding time." Martin has sold more than 40 pieces of short fiction, several articles, and two short-story collections. Naturally, the winner of the 1979 Hugo Award for most professional editor of a science-fiction publication was our own, modest *Ben Bova*.

The fifty-eighth annual Art Directors' Distinctive Merit Award went to two photographers, *Michael Somaroff* for "Natural Packages" (November 1978) and *Pete Turner* for "Road Song" (October 1978), the cover for *Omni*'s premiere issue. Both Somaroff and Turner are New Yorkers. Somaroff, a photographer with a penchant for science magazines, has produced portraitures for many of *Omni*'s interview subjects. Turner, whose expertise is special effects, claims his work is given shape by his personal vision. "I have always been an avid reader of science fiction," he told *Omni*, "and this comes through in my work."

The fifty-ninth annual Art Directors' Award was presented to several *Omni* contributors, including former *Look* photographer *Dan McCoy* for a conceptual depiction of artificial intelligence in "Intelligent Machines" (October 1979). Frenchman *Pierre Lacombe*, who at the tender age of thirty-eight began his career as an artist, received an award for our July 1979 cover.

"I was crammed into a small booth at Foley's Bar with the New York Giants' offensive team," former fashion model *Susan Mazur* told *Omni*. "They invited me there for an in-depth discussion of future football. Big-as-a-house Gordon King and Reggie Van Horne told me that after a couple of weeks at coach Ray Perkins's training camp they were looking forward to the day when they could send their clones in there to do it for them." This month Ms. Mazur takes us through the locker rooms and the labs for a look at how science is shaping the future of sports. Computers, Space Age equipment, and new training techniques combine to turn losers into "Winners" (page 44). A model for names like Geoffrey Beene, Bill Blass, and Diane Von Fürstenberg, Susan Mazur several years ago turned to the typewriter. Beginning as an editorial assistant for *Good Housekeeping*, she has since worked as the environment editor for *Popular Mechanics*, and her by-line has appeared in *Ambiance*, *Gentlemen's Quarterly*, and *Omni*.

Stephen King, author of *Carrie*, *The Dead Zone*, and *The Shining*, has penned a brilliant new chiller, "Firestarter," which we've excerpted exclusively for our readers (page 50).

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EDITORIAL OFFICES
New York 909 Third Ave., New York, N.Y. 10022. Tel. (212) 593-3301. Telex no. 237128. *West Coast* 924 Westwood Blvd., Suite 1002, Los Angeles, Calif. 90024. Tel. (213) 824-9831. *London* 2 Bramber Road, West Kensington, London, W14 9PB, England. Tel. (01) 385-6181. Telex no. 919865
U.K. & European Editions
Managing Director: Alan Root; *Advertising Director:* Eleanore Graham; *Public Relations:* Molly McKellar; *Editorial Assistant:* Andie Burland

BUREAUS
Washington, D.C.: William R. Corson, 1707 H St., N.W., Washington, D.C. *Berlin:* Hans-Hohn, Enzianstrasse 1, Berlin 45 *Rio de Janeiro:* Andre Fodor, 98 Rua Mexico, 15th floor, Rio de Janeiro ZC39 *Budapest:* Paul Kirlyhedgyi, 5 Regi posta ulca, Budapest 5, Hungary *Zagreb:* Cedomir Kornijenovic, Strebrnjak 96, Zagreb, Yugoslavia

JULY

LETTERS

COMMUNICATIONS

Technological Cheerleading
Referring to Ray Bradbury's "Beyond Eden" in the April [1980] issue, one cannot help admiring Mr. Bradbury's optimism regarding the space shuttle and its spin-off technologies, beneficial to many aspects of our society. But perhaps he is guilty of technological cheerleading if he truly believes the spin-offs will reduce, for example, our phone bills.

It is true that shuttle technologies will facilitate telecommunications and possibly even reduce the cost of providing these services, but it is equally true that those cost reductions will be passed on as dividends to shareholders, not price reductions to consumers.

Technology may change, after all, but people remain the same.

R. Wardle
Langley, B.C., Canada

Thanks to the article "Beyond Eden," by Ray Bradbury, I have been able to shut a lot of skeptical mouths about our space shuttle program.

It seems like everyone I know who does not understand the purpose of the shuttle system has nothing but gripes about our space program. Articles such as "Beyond Eden" help these small-brained people understand its actual significance.

Tim B. Taylor
Kennedy Space Center
Cape Canaveral, Fla.

In His Image
A number of investigators are studying the Shroud of Turin to determine whether it may have once covered the body of Jesus Christ. I have a suggestion that will cut through the rhetoric about the Shroud. It will be possible in the very near future to clone human beings. The Russians already have an experiment under way in which they intend to clone a mammoth (Mammoth Country Safari, anyone?). Cloning is a small technical step from this achievement. All that would be required to clone the man who was wrapped by the Shroud is a loose skin cell, of which there should be many trapped in the cloth fibers. If this cloned human turns out to be Jesus (we should be able to tell by the miracles he performs), it will revolutionize religion. Imagine the opportunity for heresies and schisms with 100 clones of Jesus! Cloning a god makes man a god. Hence, this experiment is sure to turn off the religionists.

Sandy Shakocius
Spectrum Technology Service
Palos Verdes, Calif.

Last Words
Your Last Word column [May 1980] did a terrible injustice to a good science-fiction movie, *Alien*. In the article you call the crew of the ship *Nostromo* idiotic for not opening all the hatches to let the creature blow out at the beginning of the movie instead of waiting until the end. They could not have blown the creature into space at the beginning because the main body of the ship was far away from any portal. At the end of the film it was in the small, one-roomed shuttle, and only then was it close enough to a door to be sucked out into space.

John Moran
Springfield, Va.

We of Battle Creek are sensitive to the needs of our community, including its monsters [Last Word, April 1980]. Aided by the research of a special committee and certain allocated funds, we are currently constructing a sewer that promises to be the ultimate in subterranean comfort. Certainly a monster will harbor little desire to prowl our fair city when it can bask in sunken luxury.

More cities should adopt this concept of "peaceful coexistence" within their incorporated boundaries. We of Battle Creek are proud of the example that we are setting.

Chuck Asher
Battle Creek, Mich.

I must make some correction in the April 1980 Last Word.

Specifically, I am referring to the part on the *Punxsutawney Parallelogram*. Having lived in Punxsutawney for a while myself, and having many friends and relatives

CONTINUED ON PAGE 125

DIALOGUE

FORUM

In which the readers, editors, and correspondents discuss topics arising out of Omni *and theories and speculation of general interest are brought forth. The views published are not necessarily those of the editors. Letters for publication should be mailed to* Omni *Forum*, Omni *Magazine, 909 Third Avenue, New York, NY 10022.*

Support Our Space Program

I am directing this letter to college students. Having learned of the death of both the Galileo and Halley's Comet/Tempel II missions and the embarrassing delay of the shuttle program—and having seen the space program pushed aside by our government on every account—it is about time that those of us who support our space program, our future, address the issue.

The method for letting the government know how we feel is simple. Begin a petition at your college, collect signatures, and submit them to the proper offices of the President and Congress:

- Adviser to the President on Space Affairs: Benjamin Hubberman, Executive Office Building, Washington, DC 20500
- Director of Space Science and Applications; House Subcommittee: Don Fuqua, Room 226, Rayburn Office Building, Washington, DC 20515
- Director of Science, Technology, and Space; Senate Subcommittee: Adlai E. Stevenson, U.S. Senate, Washington, DC 20510.

There are nearly 1,000 colleges and universities in the United States, with an average of 2,000 students per institution. We represent a powerful force, and we can change our future.

Peter H. Diamandis
Great Neck, N.Y.

Self-Righteous or Good Gardener?

Most of James Randi's comments in *Omni* [Interview, April 1980] seem correct. Yet, as Randi rails against the showmanship of a Uri Geller, he's busy grandstanding with his own Uri Awards and the Randi Challenge. He cites cases that smack of slow-witted folk he deems acceptable for ridicule. Little wonder his offers to prove claimed abilities are turned down: Who wants to be the public fool?

The problem lies in the arrogance of self-righteous campaigns. What people believe may be foolish or even dangerous, but the right to those beliefs must be protected. Carl Sagan recommends strong public education to inform and affect those beliefs. We need to understand the connection between *belief* and *fact*.

As Sagan has pointed out, science is not so much a body of knowledge as a way of thinking. The working scientific imagination appreciates the quality of metaphor in the Uncertainty Principle or the Second Law of Thermodynamics as well as the progression from impossible to possible. I find it intriguing that four pages away from the Randi interview, Arthur C. Clarke suggests that "when a . . . scientist says that something is possible, he is almost certainly right. When he says it is impossible, he is very probably wrong."

Richard Currey
Farmington, N. Mex.

James Randi's story about his "karate" demonstration mostly serves to demonstrate his lack of understanding of the nature of karate and the purpose of board breaking. We are concerned about the erroneous and dangerous impression he has created—and more concerned that he seems to be arguing more from bias than from an examination of the facts.

One of us (M. David Stone) is a science writer and a third dan black belt in Tae Kwon Do, which he has been studying for over 13 years. The other (Richard A. Brandt) is a theoretical physicist and a second dan black belt. Both of us share Randi's skepticism about ESP.

While it is certainly true that almost anything can be faked, the fact remains that any black belt in any legitimate style can break unprepared, unsawed, undried wood. In our style, for example, part of the test for first dan consists of breaking a minimum of three inches. Despite the impression that Randi gives, this is not all that easy. People who have been studying karate for two or three years can have trouble with this part of the test and, in fact, students have been known to miss a break and injure themselves. Breaking a bone in the hand or foot, while rare, is not unknown. The point is, just because Randi can show how something *can* be faked, it does not follow that it *must* be faked.

What bothers us is that Randi's comments about karate, based on minimal research and sloppy thinking, demonstrate such a complete lack of reliability that we can't help wondering if his debunking of, say, Uri Geller is just as baseless. We suspect not, but we urge Randi to be more careful, or he may do his cause more harm than good.

M. David Stone
Professor Richard A. Brandt
New York, N.Y.

Congratulations on your interview with the Amazing Randi. He deserves three cheers for his important work of debunking charlatans like Uri Geller. They have spawned a whole new generation of starry-eyed kids and true believers whose mushy sentimentality and pseudo-scientific jargon sprout like weeds in the well-tended gardens of science. If these weeds aren't checked, they will choke the real and beautiful flowers of true science that mankind has labored so long to cultivate. James Randi is one of the good gardeners, and he should continue wielding every spoon he has bent by honest trickery rather than by paranormal power as he goes about his weeding.

Immanuel Chin
New York, N.Y.

In April you ran an interview with James Randi the magician. He described certain procedures used in judging a series of experiments at Stanford Research Institute [SRI]. On the basis of his description, he concludes that the results were "grossly dishonest." Having been one of the judges who carried out the "suspect" procedure, I find that his description and my experience are in no way similar. I was there. No one knows where Randi gets his version from. He has made this false claim before

and has been informed of its inaccuracy, yet he persists in what can only be called "gross dishonesty." Before you publish such near-libelous attacks against legitimate researchers, made by a circus magician who feels his craft threatened by reality, you might at least investigate the claims.

Peter Schwartz
SRI International
Menlo Park, Calif.

James Randi replies: *The "slow-witted folk" mentioned are those touted by parapsychologists as miracle workers. And a magician who makes a fool of his helper makes a fool of himself as well. Not understanding how a trick is done makes no one a fool—except in his own mind.*

I have never attempted to delete people's choices. I agree 100 percent with Sagan—and I attempt to supply alternatives to the claptrap that passes as science in the field of the paranormal. If a thing is fact, it cannot be "many things to many people"—if those people are sane. We are being told that 2 + 2 ≠ 4, and I cannot accept this. Also, I have never said that the things I criticize are impossible; I have said only that they are unlikely, in the same way that meteorites and X rays were unlikely. They are now established facts. Show me evidence and I will accept psi along with meteorites and X rays.

Several karate buffs took exception to my reference to board breaking and interpreted my comments to mean that I implied cheating. Not at all. I simply said that board breaking as I have seen it—and I've seen a lot of it—is easily done without rigorous training or preparation. Some 260 requests for the $10,000 offer rules came to my door, and all have been answered. As expected, a certain number of pink-crayon-on-a-brown-paper-bag items were included. And, I must add, a satisfying number supporting my point of view. In months to come, I will be testing those who pass the preliminaries, and a report will be made to Omni *of the results.*

As for Mr. Schwartz, I have no idea which of the multitude of experiments at SRI Mr. Schwartz was involved in, since the judges usually are not identified—probably for very good reasons. I have ample evidence that reports from SRI were often misrepresentations. Such data will be reported in my book Flim-flam, *due for publication in September. As for the threat, it cannot apply to my craft, for we conjurers openly—with a few exceptions—admit that we are* simulating *miracles, and we leave the claims of real magic to the paranormalists and children.*

My claim is not false.

Nuclear or Natural Threat?

In *Omni* [Earth, April 1980] you discuss the flash of light detected by the Vela satellite. As the article states, the experts suspect that the flash was caused by some sort of nuclear device. There is another explanation possible not discussed in the article. The flash could have been caused by a natural phenomenon similar to the Tunguska explosion of 1908. In the UFO Update column of the October 1979 issue you summarized what was known about the 1908 explosion. The article then told of a similar explosion that had taken place over Revelstoke, Canada, in 1965. This blast, in the kiloton range, was directly attributed to a meteorite, possibly a chunk from Encke's Comet.

I suggest that the flash seen by Vela was another such meteorite. First Vela saw a double flash, suggesting that the hypothetical meteorite was breaking up so that the different pieces did not explode simultaneously. Vela did not detect the radiation and magnetic disturbances that would have resulted from a nuclear blast. There have been no repeated indications of any radioactive contamination in the area and waters that would have been affected by a nuclear blast. How does the flash compare with the explosion in Canada? I believe that this possibility should be investigated and, if shown to be probable, firm steps should be taken to curb a menace to mankind.

Ronald A. Berends
Buffalo, N.Y.

Technological Intrusion

"Cesarean Boom" points out the folly of misplaced technology. More and more women are realizing that their bodies are capable of handling the "trauma" of childbirth. K. C. Cole is supporting the popular misconception that childbirth is a complicated medical problem.

The fact is, however, most births can and should be completely natural. Fear is the number one factor in the pain most women endure in labor. A relaxed, warm, welcoming atmosphere is a benefit to both mother and child. A Cesarean section is a drastic step that results in medical complications for the mother and infant.

Contrary to Cole's implication that Cesarean sections result in more "perfect babies," it has been recognized by many open-minded physicians since the 1930s that the best method of delivery is as natural a way as possible. Childbirth is as natural as copulation. A technological intrusion would not be necessary if women were encouraged to know what is happening during labor and delivery. It is a gross mismanagement of resources when a completely healthy person is subjected to unnecessary surgery. The birth of a child is a wonderful thing. "Cesarean Boom" makes it sound like a gallstone removal.

R. Findlay
Thunder Bay, Ont., Canada

More on Cattle Mutilations

I feel I must respond to Alan K. Bingham's letter [Forum, April 1980] on the cattle mutilation mystery. Bingham suggests that the federal government is monitoring the long-term effects of nuclear tests in the West by surreptitiously killing and dissecting privately owned cattle.

While our government loves to do simple things in complex and expensive ways, it seems unlikely that it would risk flying a fleet of helicopters at night over rough and often mountainous terrain. If Bingham is correct about the government's intentions, it would be much easier to dress an intelligence agent in civilian clothes and have him purchase the animals as any other cattle buyer does. Another plan would be to have FDA meat inspectors in slaughterhouses collect the needed parts, which could later be diverted to the appropriate government agency.

I have been deeply involved in the investigation of these strange animal deaths since 1974, when a series of them occurred in my home state of Minnesota, where the military has never conducted nuclear or chemical-warfare experiments. Later this year Manor Books will publish the results of my investigations. This book, provisionally entitled *The Terror*, details many incidents that have been suppressed by law-enforcement agencies; it also offers an explanation of the mutilation mystery that will rock the scientific establishment to its foundations.

Michael D. Albers
Minneapolis, Minn.

As Time Goes By

The case is *not* closed! In the April 1980 Games column, your "Clock Problem" states that in 12 hours, the hands of a clock are coincident 11 times. You are wrong. Start counting at: (1) 12:00; (2) 1:05; (3) 2:10; (4) 3:15; (5) 4:20; (6) 5:25; (7) 6:30; (8) 7:35; (9) 8:40; (10) 9:45; (11) 10:50; (12) 11:55. The next 12 hours would be started again at 12:00. Take time to consider it.

Lynn Ericksen
Lockport, Ill.

Scot Morris replies: *In the introduction to this puzzle, I said it was a great one for starting arguments—and I was right. How can the hands of a clock coincide at 11:55 and again five minutes later at 12:00?*

For the record, here are the times that clock hands are coincident, worked out by David Cortner, of Johnson City, Tennessee, and George Kelley, Jr., of Glade Spring, Virginia, and accurate to the nearest hundredth of a second:
(1) 1:05:27. 27; (2) 2:10:54.55; (3) 3:16:21.82; (4) 4:21:49.09; (5) 5:27:16.36; (6) 6:32:43.64; (7) 7:38:10.91; (8) 8:43:38.18; (9) 9:49:05.46; (10) 10:54:32.73; (11) 12:00:00.00.
The clock hands are not coincident at 1:05, as Ms. Ericksen and several other readers suggest. At 1:00 the little hand points to the "1," but five minutes later when the big hand points to the "1," the little hand has already moved on one twelfth of the way toward the "2," etc. Case closed. Again.

LIVING PLANET

EARTH

By James E. Lovelock

Imagine the control deck of a space ship as it approaches a newfound planetary system. The commander turns to his chief exobiologist and asks, "Do any of these planets bear life?"

The C.E. replies confidently, "Planet Three has abundant chemical life, along with an atmosphere we can breathe."

How could the C.E. tell? By using the telebioscope, which is able to detect life across tens or even hundreds of millions of kilometers of space. The device, developed under NASA's sponsorship 15 years ago, uses the information in reflected sunlight to determine the contents of a planet's atmosphere.

There's nothing unusual about finding some surprises when a new invention is used. The telebioscope, or life detector, was no exception. When turned around and trained on Earth, it spun off the astonishing suggestion that life on our planet is integrated on a global scale. Earth, as a planet, is *alive*.

An entity as large as a planet and with the power to control its own habitat needed a name to match it. William Golding, the novelist, suggested Gaia, the earth goddess of the Greeks. It also needed a collaborator to put some flesh onto the bare bones of theory. I was indeed fortunate to have Lynn Margulis help me to develop Gaia.

The evidence for Gaia's existence ranges all the way from astronomy to zoology. Stars in globular clusters shine more brightly as they age. If our sun has done the same, its output of radiant energy has increased by 25 percent since life began on Earth.

This raises some questions: Why hasn't Earth's temperature risen accordingly? Why aren't we now boiling? The answer is: Our climate depends not only on the heat of the sun but also on the gases of the air and on the reflection and emission of radiation from land and sea.

The average temperature of the earth has scarcely varied from what it is today. The ice ages have affected only the relatively unimportant upper 15 percent and lower 15 percent of the planet's surface, while the regions around the equator, which include 70 percent of the earth's surface and most of its life forms, have been immune from ice cover.

It is possible that the sun, air, and surface of the earth have always changed by accident to maintain a constant climate. To have done this for 3.5 billion years, however, stretches credibility. A more likely alternative is that life responded to changes by modifying the surface and atmospheric composition so as to maintain the optimal climate. This is one of the arguments for Gaia.

Mars, Earth, and Venus are thought to have had very similar compositions at their origin. We might expect, therefore, that a lifeless planet interposed between Mars and Venus would be an average of the two. It would have an atmosphere rich in carbon dioxide, but with only traces of oxygen. This imaginary planet would have evolved into something vastly different from our present-day Earth, for it wouldn't have experienced life's powerful and continuous manipulation of the entire planetary surface. If life can make such enormous changes, it seems perverse to deny it the capacity, through Darwinian evolution, to make them so as to favor its own survival.

Life uses the atmosphere of its planet as a convenient, mobile medium for the exchange of its chemical products. Methane and oxygen are present in large quantities in Earth's atmosphere, and from this alone it would be possible, using the telebioscope, to deduce that life existed on this planet. Yet the great fluxes that these and other gases undergo in relation to the earth's crust suggest that the entire biosphere must be involved in the gas transfers, for inorganic processes simply could not handle the volume of the reactions. Air is not passive, but is a part of life and its interactions with the planet.

What is the function of a gas such as methane or oxygen in the atmosphere? Ordinarily such a question would rightly be condemned as teleological. It is the role of science, after all, to study the mechanisms of nature, not to look for some purpose or design. But if for the sake of argument we assume that Gaia does exist, then the question is no more illogical than

CONTINUED FROM PAGE 124

The telebioscope has turned up the startling suggestion that the earth as a planet is actually alive.

HEIR APPARENT

LIFE

By Dr. Bernard Dixon

Acquired characteristics *may* be acquired after all. Certain abilities developed during a person's lifetime may be passed on to offspring, as claimed by the French biologist Jean Lamarck but vigorously repudiated by both early and present-day followers of Charles Darwin.

That bold assertion, which clashes violently with a central tenet of modern biology, is made by the young immunologist Dr. Ted Steele in his provocative book, published recently, called *Somatic Selection and Adaptive Evolution* (Williams and Wallace, Ltd.). An Australian, Dr. Steele has worked at the University of Adelaide, the John Curtin School, in Canberra, Australia, and the Ontario Cancer Institute, in Toronto, Canada. He is now in London to continue experimental work that he hopes will provide overwhelming support for his controversial views.

Many adherents of Lamarckism were won over by its simplistic appeal, rather than by its scientific underpinnings. Jean Henri Fabre was one great writer who refused to accept that life's beautiful adaptations, in solitary wasps, for example, are based on nothing more than this Darwinian selection of purely random mutations. But ever since we learned that the genetic material in germ cells (ova and spermatozoa) is in a sense isolated from the rest of the body, it has been impossible intellectually to accept Lamarckian evolution. There simply is no route by which acquired behavior can be incorporated in the DNA code of germ cells and bequeathed to ensuing generations.

Why, then, has Steele's book been endorsed by such noted philosophers of science as Arthur Koestler and Sir Karl Popper and by Nobel Prize-winning molecular biologists Dr. Howard Temin and Sir Peter Medwar? Until now the scientific establishment has been unwavering in its opposition to Lamarckism. And Ted Steele does not go out of his way to seduce potential critics. On the contrary, his book shows all the blunt brashness of youth.

Steele has *not* been damned without a hearing, largely because he bases his theory on the fantastic abilities of the immune system. Scientists have long been baffled by the body's skill at generating antibodies to fight off an almost endless barrage of foreign intruders. So when Steele offers a plausible explanation—even when that explanation invokes Lamarckian evolution—he must be taken seriously.

The riddle at the center of immunology is this: How can we and other animals produce an astronomical range of different antibodies that specifically react against not only disease-causing bacteria and viruses but also novel products of the chemical industry? To take an extreme case, we know that a baby, a rabbit, an elephant, or a mouse not yet born will be capable of making antibodies that specifically neutralize a totally new chemical that has not yet even been synthesized.

There seem to be just two possible mechanisms at work here. Foreign substances either *instruct* cells to fabricate particular antibodies (for example, they might imprint their patterns on those cells, telling them the complementary shape of antibodies to produce), or they *select* antibody-making cells from a preexisting catalog of possibilities.

Lamarck: He may have been right after all.

Neither idea seemed remotely believable until about 20 years ago when another Australian, Sir Macfarlane Burnet, apparently solved the enigma. He suggested that the mutation and selection we observe in populations of monkeys, fruit flies, and bacteria might also work among the cells of an individual creature. This generates a wide range of antibody-making capabilities. So when something foreign appears, the appropriate cells are stimulated and their production lines begin to turn out antibodies of the "nearest fit."

For a while everyone was satisfied with this explanation. But then biologists began to realize that Burnet's theory didn't really answer the central question of how immunological diversity appears in the first place. Where does that catalog of information come from?

This is where Ted Steele provides a hazardous, brave, but liberating explanation. Like everything else in the body, he points out, the immune system has a genetic basis. *Something* is inherited. Could it be that the adaptations of one lifetime—the mutations that generate antibodies to protect that individual—might be incorporated into the DNA passed along to the next generation? Steele believes that this is precisely what happens. Cells are selected, as Burnet suggests, but then the relevant information in them is transferred into the animal's DNA. How this occurs, Steele cannot be sure, but one possibility is that a virus performs the task of inserting the coded data. Viruses certainly do transfer genetic instructions among bacteria. Maybe they also do it in animals.

That is fundamentally a Lamarckian proposition. And it has straightforward predictions that can be tested, which is exactly what Steele is doing. After a long and bitter battle to debunk Lamarckian theory, Darwinists may now have to settle for a compromise.

CATACLYSM

SPACE

By Brian O'Leary

On June 30, 1908, a ten-megaton bomb exploded at a height of ten kilometers above the pine forests of Tunguska, Siberia. Trees toppled and branches sizzled over an area 60 kilometers across. About 1,500 reindeer were killed, and a man standing on his porch was knocked flat. Shock waves registered on seismographs the world over, and the sound was detected in Europe, thousands of kilometers away. A brilliant fireball flared in broad daylight. The explosion released as much energy as a small hydrogen bomb.

What caused it? Probably a small comet or an extinct comet-turned-asteroid. The loose agglomeration of dust and ice, probably 60 meters across and weighing 100,000 tons, exploded in midair with a potential for destruction far exceeding 1,000 falling *Skylabs*.

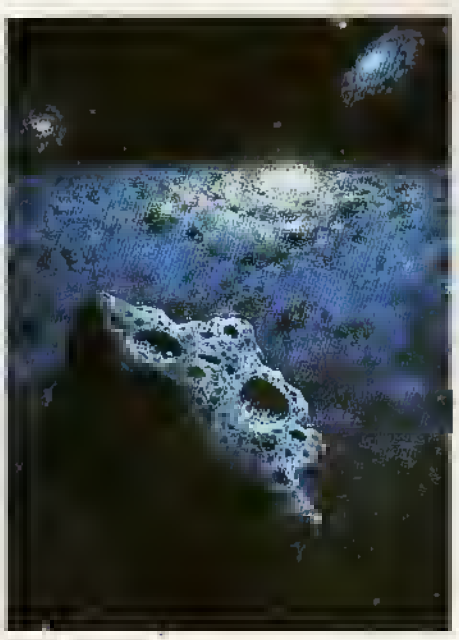
The fear that this sort of thing will occur again has become a mainstay of formula science fiction. (Have you seen the movie *Meteor* or the oft-repeated TV movie about a comet that explodes over Phoenix?) It is a fact, however, that such collisions have happened before and that others will occur, not necessarily over uninhabited wastelands. The cataclysmic impacts of larger comets, asteroids, and meteorites may even be a major factor in changing Earth's climate and geology and the evolution of living things.

The meteor crater near Winslow, Arizona, is an example of asteroid collision in geologically recent times. The crater was caused by the impact, about 22,000 years ago, of an iron-rich asteroid 50 to 100 meters across and weighing several hundred thousand tons. This asteroid, like many others, might have originated in the asteroid belt between the orbits of Mars and Jupiter and was pulled into a new, unstable, earthward orbit by planetary perturbation.

Our even less frequent, very energetic collisions with Earth-approaching asteroids could have had a profound influence on the evolution of life. Berkeley Nobel laureate Louis Alvarez and his coworkers have found that some deep-sea limestones contain unexpectedly high amounts of platinum and iridium, suggesting influxes of extraterrestrial material. Some deposits containing 30 to 160 times the normal level of iridium date to an event 65 million years ago—precisely the time of the Cretaceous/Tertiary extinction.

They suggest that the impact of a ten-kilometer asteroid would account for both the extinctions and the iridium. Pulverized rock uncovered by the impact would "stay in the stratosphere for three to five years and be distributed worldwide," Alvarez reported. "The resulting darkness would suppress photosynthesis, and the expected biological consequences match quite closely the extinction observed in the paleontological records."

How abundant are these Earth-approaching asteroids, and how likely are we to get hit? We can work out a good estimate by combining the number and size of craters on the moon with data on the 50 Earth approachers whose orbits are known. There are probably at least 100,000 such asteroids with diameters greater than 100 meters and weights of a million tons or more. The true figures may be half these estimates or double them, but they are probably no further off. Clearly, there are many close-passing asteroids waiting to be discovered—and waiting to crash into Earth.



Will an asteroid destroy civilization?

It should come as no surprise that Earth-approaching asteroids may be the parents of meteorites that land on Earth. Scientists who study changes in asteroidal orbits have concluded that nearly all the ones we've seen will eventually strike Earth, Venus, Mars, or the moon. Most of these events will occur over the next 10 million years.

How big does a meteor have to be to cause havoc on the scale of the Tunguska event? How often does this happen? How many lives would be lost, and how much property? Small meteorites are more common than large ones (more than a ton of meteorite dust falls on Earth every day—not enough to leave any visible trace). Which sizes are most likely to be dangerous? Should we run for cover?

Dr. Bruce Murray, director of the Jet Propulsion Laboratory, in Pasadena, California, recently called together a number of scientists to examine these questions. Though more information is needed to answer them conclusively, the scientists agreed that there is at least a small chance that a meteor fall in our lifetime could cause an enormous number of deaths and destruction amounting to billions—maybe even hundreds of billions—of dollars. "It is irresponsible," Murray said, "to ignore the hazard of Earth-crossing asteroids."

The workshop scientists disagreed on how often a Tunguska event might happen because data for objects of that size are very scarce. Cometlike bodies that would explode in the atmosphere may be more common than solid bodies. So it is possible that we could have ten-megaton events every few decades.

Princeton physicist Ted Taylor speculated on the losses that would result from the impact of a one-kilometer asteroid—an event that befalls Earth every hundred thousand years or so. He envisioned devastation far greater than we

CONTINUED ON PAGE 115

GHOST STORY

MIND

By Morton Schatzman

Ruth stared at the television screen. The black-and-white checkerboard pattern on the screen reversed itself once a second. Electrodes on Ruth's scalp showed, through an oscilloscope, that electrical waves from the vision center of Ruth's brain were stimulated each time the checkerboard reversed itself. Ruth was experiencing a reaction called the visual evoked response.

Peter B. C. Fenwick, a London psychiatrist and neurophysiologist, and I were interested in Ruth's visual evoked response for an unusual reason: She claimed to see apparitions that looked as real to her as living persons did. These apparitions did not have the insubstantial quality of ghosts or dreams. Ruth said they obstructed her view of things just as real people would. Their feet were literally on the ground: They walked, stood, and sat on furniture; they never flew or floated on air. If people talked with Ruth, the apparitions would follow the conversation, sometimes making relevant remarks only she could hear. When they left a room, they walked out the door, not through a wall. They never simply vanished.

For Ruth, an American mother in her mid-twenties, the only difference between her apparitions and living persons was that no one else saw them. Dr. Fenwick and I were trying to see whether an objective test would corroborate Ruth's experience.

We asked her to create an apparition between the checkerboard pattern and her eyes. Ruth had acquired the ability to produce apparitions at will as a result of therapy to eliminate her original terror of them. We had taught her to accept and control the images, not repress them. Now Dr. Fenwick and I wanted to use that control to test the effects of the apparitions on Ruth's brain.

While staring at the pattern, Ruth imagined an apparition of her seven-year-old daughter, Heather, sitting on her lap. "Her head is in front of my eyes," Ruth said, "and I see the part in her hair and her pigtails. She's blocking out the screen."

The electrical activity of Ruth's brain during 16 pattern reversals was averaged. Her visual evoked response pattern had vanished completely!

"You've won!" Peter exclaimed.

"What's happened?" Ruth asked.

"Your brain has behaved in the same way it would have if your daughter had actually been sitting on your lap," Peter said. "You've produced the appearance of a real person."

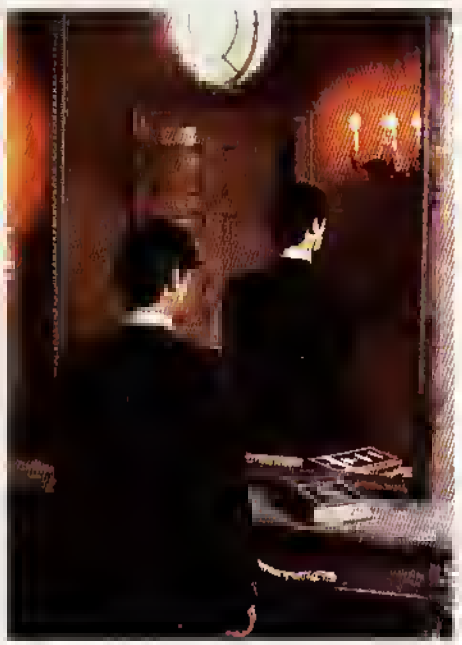
"But I could have told you that," Ruth replied.

"Yes, but your saying so isn't the same as our proving it."

We repeated the experiment several times. When Ruth said her daughter's head blocked the checkerboard pattern incompletely, the visual evoked response was reduced but not eliminated. Ruth's reports of how completely the screen in front of her was obstructed consistently corresponded with how much the oscilloscope showed her visual evoked response was inhibited.

"It's nice that the electrodes can tell you what I'm seeing," she said.

"How do you make an apparition?" Peter asked Ruth.



"I stop paying attention to everything around me. I decide whose apparition I want to make. I remember what the person looks like, as most people do with their eyes closed, except my eyes are open. And I produce the person."

Where did Ruth's brain intercept the visual stimuli that she stopped seeing when the apparitions got in the way? Was her retina, the light-sensitive surface at the back of her eye, registering the stimuli? An electroretinogram, which measures the electrical response of the retina to light, showed that Ruth's retina responded normally to a beam of light shining at her eye. When she had an apparition cover her eye, the electroretinogram showed no change. In complete darkness, she had an apparition turn the light on, and the electroretinogram again showed that no change had occurred in her brain patterns.

That the apparition had not affected the response of her retina was unsurprising, as retinal responses are not controlled by the brain's cerebral cortex, where consciousness and will originate. We now knew that the blocking of her visual evoked response to light had occurred after the light had been normally registered by her retina.

Next Ruth sat with earphones, listening to clicks being delivered at a rate of about two a second.

She said she could hear the sounds of footsteps and sometimes of clothes rustling when an apparition walked and of doors opening and closing when an apparition left a room. She also allegedly heard apparitions speak. If a living person and an apparition spoke simultaneously, she found it difficult to follow what either was saying, because she heard the sounds of both at once.

The clicks Ruth heard in our test are a standard stimulus for eliciting the auditory evoked response from that part of the brain involved in hearing. Peter and I wanted to learn whether an apparition could inhibit auditory response, too.

"Could you have your daughter turn down the volume control on the machine producing the clicks to the point where you can't hear them?" Peter asked. He showed.

CONTINUED ON PAGE 110

THE ARTS

By Robert Silverberg

One of the least likely success stories in science-fiction publishing is a small company that puts its books out in editions of a few hundred copies, doesn't bother distributing them to bookstores, and prefers to issue—at prices ranging up to $35—novels long available in paperback. Since 1975, **Gregg Press** has released several hundred books by Alfred Bester, Fritz Leiber, Poul Anderson, Robert A. Heinlein, Isaac Asimov, Roger Zelazny, and almost any other first-rank SF writer you can name. As quality science fiction becomes more appealingly collectible, this modest publishing house is enjoying steady profits and overwhelming critical acclaim from writers and editors.

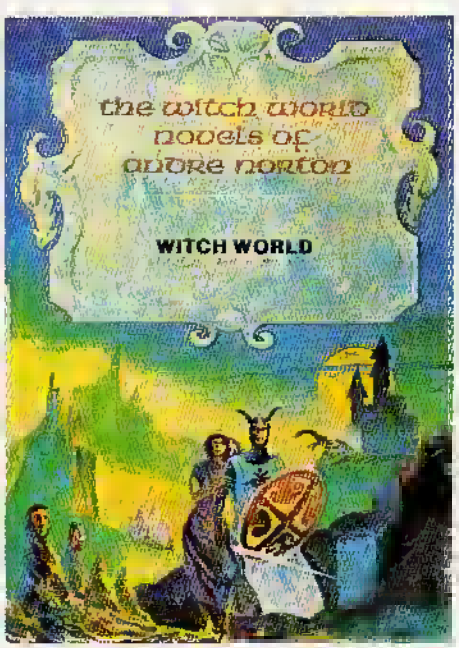
Headquartered in Boston, tiny Gregg Press belongs to the multitentacled empire of International Telephone and Telegraph Corporation—a fact Gregg does not work hard to publicize. Some 20 to 30 books a year appear under the Gregg imprint. Though Gregg pays next to nothing for publication rights—$250 is a typical advance for a famous novel—writers who draw 50 times as much from paperback companies are eager to have Gregg reprint their books.

"For an author to see his work transmuted from temporary little paper editions into splendid, strong, and durable editions," says novelist Philip K. Dick, "is the dream of a lifetime. Seeing the superb Gregg Press editions of my novels and story collections gives me the impression that what I have done amounts to more than a temporary bubble that one day will pop into oblivion. These matched editions are the pride of my bookshelf, and would be even had I not been the author."

Andre Norton, whose seven-volume Witch World series has been Gregg's top seller at $50 per set, says, "Certainly I am very proud and pleased that my titles have been gathered into well-designed and uniform sets, and I very much appreciate the chance to have my work appear under the Gregg imprint."

Gregg's editions provide an ego trip for authors that goes far beyond putting old paperbacks between hard covers. As any despondent librarian will admit, most books printed in the twentieth century are not going to survive very far into the twenty-first. The chemicals that are used in modern papermaking processes guarantee that treasured first-edition Heinleins, Asimovs, and Bradburys are going to self-destruct in another generation or two and that those paperback Sturgeon, van Vogt, and Leiber classics, however carefully tended, will perish of natural causes long before the first human explorers land on Mars. But Gregg—almost alone in contemporary SF publishing—uses high-quality, acid-free paper that will save its titles from the doom that awaits other books. Even such obscure SF works as William N. Harben's *The Land of the Changing Sun* and Charles Romyn Dake's *A Strange Discovery* are assured immortality by Gregg Press reprints.

Gregg tickles authors, librarians, and book buyers with elegant buckram bindings of uniform design, stamped in red and gold. A group of Gregg titles—most are issued without dust jackets—



First cover of Gregg's best seller Witch World.

gleams on the bookshelf like some imposing nineteenth-century collected works. And each title is accompanied by a lengthy and searching introduction by a well-known scholar or author. Among those who have done such essays for Gregg are Michael Bishop, Algis Budrys, Joe Haldeman, Barry Malzberg, Michael Moorcock, and Norman Spinrad.

The Gregg program was born in 1972, when Thomas Beeler invited New York editor and book collector David G. Hartwell to act as consultant for a line of hardcover reprints of SF standbys. Hartwell, a formidable wheeler-dealer whose inexhaustible energies have made him perhaps the single most powerful and influential figure in contemporary science fiction, threw himself into the project with characteristic gusto, but behind-the-scenes complications delayed the first series of 20 Gregg Press titles for nearly three years. Since then, titles have appeared in annual bursts. From the beginning Hartwell's coeditor has been rare-book dealer Lloyd Currey (in the early years they were assisted by Richard Gid Powers, of the City University of New York).

The original emphasis of the Gregg series was scholarly, austere, almost rarefied. The first 20 books included 9 virtually forgotten nineteenth-century works, some equally unfamiliar early-twentieth-century ones, and hardly anything by modern masters of the genre. Much of the newer material already had one hardcover incarnation and was merely being brought around again for the benefit of librarians looking to replace worn-out editions of out-of-print books (Walter Miller's *A Canticle for Leibowitz*, for instance, or Olaf Stapledon's *To the End of Time*). But also on the first list was Bester's *The Stars My Destination*, which qualifies for anybody's top-ten ranking and which had never been published in the United States in hardcover before. Gradually it dawned on collectors that here was a genuine first American hardcover edition—available only in some 250 copies. The books were snapped up.

"We haven't ceased republishing early classics," Hartwell says, "but we've

CONTINUED ON PAGE 116

THE ARTS

By Jonathan Rosenbaum

Speculating on what movies of the future will be like, it's hard to get very far without some notion of the changing needs of audiences. A crucial part of this change can be detected in *where* we see movies. According to present signs, it seems pretty clear that most of the films we'll see will be either in homes or at shopping malls.

"Once inside a mall, shoppers have few decisions to make," the magazine *Dollars & Sense* recently noted. "Corners are kept to a minimum so the customers will flow along from store to store, propelled, as the developers say, by 'retail energy.' " It's a description that fits several recent movie blockbusters—and others we can expect to see in the future.

By contrast, the movie houses that traditionally cropped up near the centers of towns—public gathering places, not unlike the municipal squares they were often adjacent to—are quickly becoming nostalgic emblems of another era.

Shopping malls, meanwhile, are sprouting virtually everywhere—mainly, it seems, on the outskirts of towns; away from these old centers. Their overall rate of failure during the past 25 years is said to be less than 1 percent. Almost half of the retail business in the United States currently takes place in them.

These 18,000 strip and enclosed complexes—also known as plazas and centers—represent only one part of our movie fare to come. It seems probable that an even more substantial portion will be represented by what we watch at home, on video equipment.

The advent of cable TV and closed-circuit home video brings home viewing and mall viewing together in a number of striking ways. In recent years the U.S. Supreme Court has twice ruled, in separate cases, that malls are *not* public places where citizens can freely congregate, express their views, or hand out leaflets. One mall expert, William Severini Kowinski, has shrewdly labeled them the "feudal castles of contemporary America.

"By keeping weather out and keeping itself always in the present—if not in the future—a mall aspires to create timeless space," Kowinski argues. "Removed from everything else and existing in a world of its own, a mall is also placeless space."

What are most big movies today, after all, but models of effortless, dovetailing mall design—channels of automatic drift where diverse products are offered and difficult choices are kept to a minimum? An *Apocalypse Now* glides us past both Michael Herr's *Dispatches* and Joseph Conrad's *Heart of Darkness* in the bookstore, the Doors as well as Wagner in the record shop, and roast beef along with plain rice in the fast-food outlets.

Similarly, a *10* will get you *Penthouse* and *Holiday* at the newsstand, Dudley Moore and Julie Andrews in the swanky nightclub, and, from the chain department store, a telescope that you can take home to spy on your neighbors. If we stay at home and tape ourselves instead, then play our images back on giant screens, the overall ambience might not be all that different. This might help to account for the strange fact that malls and homes are fast beginning to resemble each other, in looks as well as functions.

From one point of view, the *Star Trek* meals recently featured at McDonald's hamburger franchises can be seen as a plausible extension of consumer pocket power collaborating closely with shopping-mall marketing strategies. Both movies and malls today are all-inclusive entities that tend to impose a certain uniformity everywhere.

Thanks to recent multiple tie-ins between movies, comics, TV programs, toys, and burgers, the promotional possibilities here become virtually infinite. "*You've read the book*," ads used to crow, "*now see the movie!*" In the future, they might well proclaim, in graceful succession, "*You've seen the movie, now read the book*," "*You've read the book, now eat the meal*," and "*You've digested the meal, now go on to the T-shirt!*"

Thanks to convenient one-stop shopping, no fuss, no bother. Before we know it, Big Mac may turn out to be Big Brother, and *Star Wars, Part 6* a solitary video game that we project on our own retinas—whether we leave the house or not. ∞

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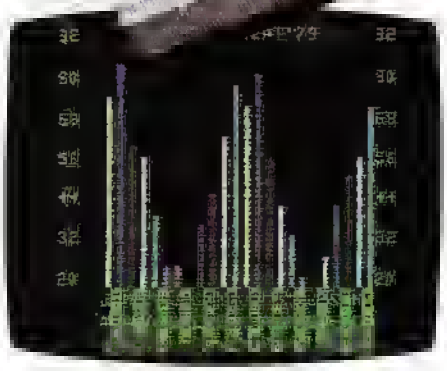

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THE RUSSIAN CONNECTION

UFO UPDATE

By James Oberg

For the past few months, grocery shoppers across the United States have been titillated by banner headlines in the *National Enquirer*. "Crippled UFO Orbits Earth," one proclaims. "First UFO to Inflict Damage on a City," "Aliens on the Moon when We Landed," "UFO Base on Saturn Moon," others announce.

The mainstream UFO movement has had the good sense to ignore these sensational claims (while often trusting the sources on other matters), but the public may well be wondering just what is going on. Few people realize that these headlines can be traced from the *Enquirer*'s editorial offices in Florida to suburban Los Angeles, and then across half a world—to Moscow!

UFOs are a sensitive topic in the Soviet Union. Such sensational headlines would never be printed there. The government officially denies alien visitations and blames such tales—with some justice—on "Western yellow journalism." The Soviet public, however, eagerly devours UFO rumors that rank among the wildest in the world, and in practice the regime appears to tolerate this as a safety valve for ideological dissent.

The reigning czar of the Russian ufologists is Feliks Zigel, an astronomy lecturer at the Moscow Aviation Institute. Zigel has written popular books and articles on UFOs, on a Soviet "bigfoot" in the Caucasus Mountains, and on similar topics. He is also the reputed author of a two-volume UFO "lecture" now circulating in the underground (*samizdat*) literature.

The cast includes some other interesting—even bizarre—characters. Science-fiction author Aleksandr Kazantsev is one. An "ancient-astronaut" enthusiast who predates Von Däniken, he claims that "God" is a case of mistaken identity that originated with alien cosmonauts—a notion encouraged in official antireligious propaganda.

Aleksey Zolotov, a provincial university professor, enthusiastically touts the idea that the Tunguska explosion in 1908 was a spaceship crash. He has vowed not to shave his Tolstoyan beard until the world admits he's right. Zolotov is also into body auras, faith healing, and altering the speed of wristwatches held in his hands.

Two physicists are also active in the USSR's UFO cult: Vladimir Azhazha and Sergey Bozhich, whose specialty seems to be embellishing foreign UFO reports and fobbing them off as Russian originals.

Reports from these Russian enthusiasts—Western newsmen are delighted to find Russians willing to talk on the record about anything—are considered highly credible by Western ufologists when they appear in UFO magazines and newsletters. They are written up in the *National Enquirer* by the Russians' American contact man, Russian-speaking Henry Gris (pronounced Gree), of Los Angeles. Gris is an editor for the tabloid and coauthor of several books dealing with UFOs and parapsychology.

Gris seems to quote the Russians with substantial accuracy, but he takes liberties with reality. Instead of identifying his sources as a small coterie of obscure enthusiasts, he turns them into "top Russian scientists" and "leading Russian physicists." Check the indexes to the world's scientific literature, however. These men's names are notably absent, though tens of thousands of genuine Soviet scientists are listed.

Their UFO stories are as questionable as their credentials. Take, for example, the flying-saucer attack on the city of Petrozavodsk on September 29, 1977. "First UFO to Inflict Damage on a City," the *National Enquirer* bannered it on April 18, 1978. Within hours after the story broke in the West, it had been solved: The jellyfish-shaped "UFO" was really the sunlit exhaust trails from the predawn launch of a spy satellite at a secret space center nearby.

The Russian populace could never be given that explanation, of course, and UFO buffs in the USSR rushed to embrace the case. "As far as I am concerned, it was a spaceship from outer space, carrying out reconnaissance," said Kazantsev.

Zolotov declared, "In my opinion, the object was a typical flying saucer. The available reports left no doubt whatsoever about that in my mind."

A purported alien craft seen during a peak of UFO activity over Switzerland in 1975.

Zigel agreed. "Without a doubt," he said, "it had all the features." And Azhazha was more specific: "In my opinion, what was seen over Petrozavodsk was either a UFO, a carrier of high intelligence with crew and passengers, or it was a field of energy created by such a UFO."

The tale of the phantom alien satellite ("Crippled UFO Orbits Earth," July 17, 1979) seems to have been simple plagiarism. Bozhich claimed to have spotted fragments of an alien spacecraft circling high above our planet, a derelict that blew up exactly 23 years ago last December 8. Unfortunately, Bozhich was obviously quoting from an American scientist's article, which in January 1969 suggested that a natural moonlet had broken up and left debris in orbit. When another American scientist pointed out the paper—Bozhich hadn't mentioned it—the *National Enquirer* proclaimed that it corroborated the Russian story.

The Apollo UFO table ("Aliens on the Moon when We Landed," September 11, 1979) went through several metamorphoses across the world. Azhazha was the main source for the *National Enquirer* story of a NASA cover-up; somehow he neglected to mention that his tale of astronauts secretly photographing flying saucers on the moon was derived from a French book by Maurice Chatelain, published here as *Our Ancestors Came from Outer Space* in 1978.

That book, in turn, was based on faked "space photos" released in 1974 by the Cosmic Brotherhood Associates, a fringe UFO cult in Japan. The pictures were forged in order to illustrate an originally Canadian hoax, which was so transparent that most UFO groups in North America rejected it in 1969.

Each of the participants in this fraud added his own personal touches to the story. The result was a family of derivatives, which the *National Enquirer* presented as independent, reliable, mutually corroborative accounts.

Bozhich's fantasies reached a new extreme in the most recent story, "UFO Base on Saturn Moon," published November 13, 1979. According to this tale, Soviet observatories had monitored alien radio signals. Their origin had been pinpointed, he added, by radar that had tracked the direction of ascending UFOs toward Saturn. One of the major confirmations was the trajectory of the Petrozavodsk UFO—the one that turns out to have been a spy satellite.

Cynics saw that Bozhich's claims were either timed to cash in on the spectacular success of America's Pioneer Saturn probe or were a reaction to the suggestion that Russian radio interference had scrambled NASA's data on Titan, Saturn's largest moon and the alleged site of the UFO base. The more gullible UFO buffs did not.

Standing opposite the USSR's UFO rumor factory is a lone Soviet official, Dr. Vladimir V. Migulin, of the Academy of Sciences' Ionospheric Physics Laboratory. His job ostensibly is to catalog incoming reports and coordinate Soviet research. He spends much of his time trying to reassure the Russian public—a hopeless task.

The case of the Petrozavodsk UFO has been especially difficult for Dr. Migulin. He denies that it could have been a "true UFO," but state security regulations forbid him to announce that it was a Soviet military spaceship. Poor Migulin is left with nothing but scientific mumbo jumbo about geomagnetic disturbances and chemiluminescent smog. The staid scientist is caught in a UFO-KGB crossfire that cannot end happily for him.

To understand the Russian UFO scene, we must appreciate how small the cast of characters really is. Russian names are spelled so oddly—and are so often misspelled by the American press—that few people even try to read them. Hence, repeated quotations give the false

"Soviet observatories had monitored alien radio signals, and radar used to track ascending UFOs had pinpointed their origin: Titan, a moon of Saturn."

impression that an entire generation of "top Russian scientists" is taking turns testifying to the reality of UFOs.

Remember that the tabloids are only recycling the same handful of obscure Russian UFO enthusiasts next time the headlines scream about another Earth-shaking revelation from Moscow. Chances are, we'll have seen those names somewhere before.

Back on this side of the Iron Curtain: Drawings of UFOs reported over the last 30 years show almost an infinite variety. Either each UFO pilot has his own customizing kit, or the UFOs, in the words of ufologist Robert Sheaffer, "are made of Silly Putty."

Or maybe the hundreds of UFO sketches on hand don't really show what the witnesses saw. That's the suspicion of Dr. Richard F. Haines, a research scientist at the NASA Ames Research Center, near San Francisco. Haines, author of *Observing UFOs* (Nelson-Hall, Chicago, 1978), is a specialist in visual perception and a scientific consultant for the Center for UFO Studies and the Aerial Phenomena Research Organization.

Haines believes the UFO phenomenon must be studied scientifically, and he reported one of his most fascinating experiments, a study of UFO perception, at a special seminar presented by the American Institute of Aeronautics and Astronautics. The experiment was a simple one: Haines asked UFO witnesses to sketch what they had seen and compared the results with UFO drawings by people who had never seen one.

Oddly enough, impartial judges couldn't tell the sketches apart. Drawings from the two groups had the same general features, and those from people who had never seen a UFO contained just as much "information" and detail as eyewitness renderings.

"The similarity of the drawings," Haines believes, "suggests that these participants hold a stereotyped image of what a UFO is supposed to look like. Almost everyone has seen a photograph or drawing of a UFO at some time, and the memory strongly influences subsequent drawings."

But shouldn't someone who has actually seen a UFO be able to give more details about their appearance than people who have seen only a picture? You'd think so.

This brings up an interesting possibility: A UFO skeptic could reasonably suggest that there is no way any preconceived image of a UFO could overwhelm the added details from a sighting unless the UFO is largely made up of preconceived images rather than external data. In other words, something cues the witness's mind to conjure up convincing details from memory. The result would be a truly imaginary UFO sighting whose appearance, honestly reported, had nothing at all to do with the form of the original stimulus.

Haines hopes that this ambiguity can be resolved by preparing recognition charts showing varied UFO shapes and sizes. Witnesses could then select from the charts to compose the image they recall much as a crime witness builds a picture of the criminal with a police identification kit. But if their perceptions of the UFO have already been short-circuited, such a scientific approach may still be worthless.

"It should go without saying," Haines concludes, "that more research is needed on the basic perceptual processes." Such research should go a long way toward demonstrating whether or not many UFOs are "all in the mind" after all.

The pity is, if the research eventually proves that something is there, it will in all probability impede rather than accelerate the process of the acceptance of UFOs by traditional science. This is because the new theories will most likely be championed by those ufologists already badly discredited by too many endorsements of what subsequently turned out to be hoaxes. They would be right only by accident, not by their own merit. ∞

CONTINUUM

MUTILATION MADNESS

How would you feel if you heard that a federal agency, a district attorney, a state government, and a U.S. senator had banded together to finance a serious study into the reality of Santa Claus? And what if the study concluded that Santa Claus doesn't exist, and then the senator condemned the investigation?

Well, something very similar has just happened. The Law Enforcement Assistance Administration and the state of New Mexico recently spent $50,000 in an attempt to clear up the controversy over cattle mutilations. As reported in *Omni*'s January 1980 UFO Update, this phenomenon involves reports that, since 1975, extraterrestrial beings from UFOs, witches, CIA agents, or other strange types have been surgically removing the rectums, eyes, ears, tongues, and genitals from more than 7,000 cattle across the country. To get to the bottom of these serious matters, the Feds and New Mexico, urged on by no less an authority than that state's Senator Harrison Schmitt, came up with the fifty grand and, under the auspices of the district attorney's office in Santa Fe, hired ex-FBI agent Kenneth Rommel to scurry over the countryside examining deceased cows.

Like any good cop, Rommel has discovered the identity of the perpetrators. For the most part, they are coyotes, buzzards, mice, flies, ants, and other scavengers. The mutilations, Rommel says, were "caused by, and totally consistent with, what one would expect to find with normal predation, scavenger activity, and decomposition." He further said, "I have not found one credible source that differs from this opinion, nor has one piece of hard evidence been presented that would cause me to alter this opinion." Rommel went on to explain that mutilation madness has been promoted by a "good deal of very creative writing" in the media.

Immediately following the report, the *Albuquerque Journal* compared Rommel to Richard Nixon, describing both as former federal employees who "subscribe and give currency to the fiction that the news media can, or do, manufacture news. . . ." Still, the cattle-mutilation notion has been very much the product of careless acceptance of sensationalistic reports from unreliable and biased sources. Advocates of UFO invasion and other theories have piled idiocy on hyperbole to present a bizarre picture of cattle in lonely areas with soft parts "surgically" removed and no traces of any agency nearby that could have done the deeds. Lack of animal tracks, carcasses drained of blood, and weird lights in the sky have been hallmarks of these reports.

But Rommel blew these angles away by looking carefully into 24 classic cases. First, he said, the precision of the alterations was greatly exaggerated. The edges of the wounds showed distinct teeth marks, and desiccation had smoothed the areas over. One rancher, intent on retaining his notions about a supernormal cause, told Rommel that "if coyotes did that, they did it with knives." Rommel countered, "I say that if surgeons did it, they did it with their teeth."

He found tracks aplenty, of common predators and scavengers. Droppings from coyotes and buzzards, which are known to consume the soft parts of dead animals as well as to tear into the body cavities to get at the internal organs, were in evidence. The bloodlessness of the corpses was attributable to the normal process of pooling of body fluids resulting from gravity, he said. Blood congeals in the lower parts, or it is consumed by scavengers as a normal process.

One mutilation, he noted, was touted as UFO-related due to accompanying strange nocturnal glows. Newspapers failed to mention that the aurora borealis that night had been exceptionally bright. Another report contained the startling claim that a mutilated steer's legs were broken as a result of a drop from some airborne craft. Rommel suggested that either the legs had been healed in some mysterious fashion by the time he got to the steer, or they had not been broken in the first place.

But Senator Schmitt remains unconvinced. While Rommel has recommended that no further public funds be spent on the matter, Schmitt said, "I do not think it [the investigation] can be taken as a definitive study." He rejected Rommel's finding that there was false information in official reports from law officers. Schmitt prefers to wait for the results from a forthcoming FBI probe being conducted separately from Rommel's investigation.

So the door has been left open for even more reports of "mutilations." But true believers should consider one final question. As Ken Rommel asked reporters when he showed them a grisly photo of one less-than-precise operation in which predators had torn out the genital region of a steer, "How'd you like *that* surgeon doing a vasectomy on you?"—*JAMES RANDI*

CONTINUUM

HOTDOGGER OR HAMBURGER?

When you go out for a quick lunch, do you prefer hot dogs or hamburgers? A Brooklyn psychiatrist recently completed a study that suggests the choice you make may reveal some aspects of your personality.

Dr. Leo Wollman, a psychiatrist, conducted the study as a result of earlier research he did in 1976 for a book on obesity and dieting. "I got caught up in the subject of food preferences and did this study just for fun," Dr. Wollman said.

The study of 3,000 persons concludes that hot-dog eaters tend to be "outgoing, aggressive, ambitious extroverts," while hamburger fanciers are "quieter, introverted, more conservative types." Wollman describes hamburger eaters as a bit on the "whimpy" side.

"The people who eat hot dogs usually grab it and go," he said. "Hamburger eaters take more time. They're better-dressed executive types, used to making decisions—well done, rare, ketchup or mustard . . ."

The sixty-six-year-old psychiatrist said there's an obvious "psychosexual" aspect to eating a hot dog: "The phallic symbolism, the way a person holds it, delicately or forcefully, the relationship to masturbation, and so on. But I didn't get into that much."

One fast-food chain lost interest in the study, and Wollman has decided not to publish the results, but he still believes it has "commercial value to advertisers."

—Allan Maurer

Hot-dog eater: A psychiatrist describes this type as aggressive, outgoing, ambitious, with obvious psychosexual overtones.

"Be careful about reading health books. You might die of a misprint."

—Mark Twain

MAKING DRUGS IN SPACE

Now there's yet another potential spin-off from the U.S. space program, and it's a big one: a cure for diabetes.

The McDonnell Douglas Astronautics Company has just signed an agreement with NASA to use the space shuttle to explore the possibility of manufacturing new drugs in space. Specifically, McDonnell Douglas wants to test continuous-flow electrophoresis, a process that can work effectively only in a gravity-free environment.

NASA will supply free space aboard the shuttle as early as 1983. Douglas and an unnamed pharmaceutical firm will make a device to be tested in orbit, which has the potential to produce large, pure quantities of enzymes, cells, and pharmaceuticals. (While the pharmaceutical company involved is officially unidentified, the business weekly *Barron's* has identified it as Johnson and Johnson, the baby powder people.)

Dave Richman, of McDonnell Douglas, says his company has already built several prototypes of the device, which will be a rectangular chamber 15 centimeters wide, 1.2 meters long, and only 0.79 millimeter thick.

"A buffering fluid of mostly water will flow slowly upward through the chamber," Richman explains, "while an electric field is laid across its width. A single stream of sample fluid is then introduced, and the electric field will put different charges on different particles in the stream, separating it into different components by the time it reaches the top of the chamber."

Earth's gravity prevents the electrophoresis process from functioning effectively on the ground; in space, Richman notes, the process should be highly effective—and profitable.

The potential products Douglas is looking at include proteins like the antihemophiliac factor, for "bleeders," and cells like the beta cells that produce insulin. "If this process can isolate beta cells in quantity," Richman suggests, "they could then be implanted in diabetics." The beta cells would then produce insulin for them. The result: not just a treatment but an actual cure for diabetes.

—Joel Davis

McDonnell Douglas technician examines drug-making device.

BIO-SLIMMING

The role of the hormone insulin in regulating blood-sugar levels is one known intimately by every diabetic. Now a group of researchers at the University of Washington Health Sciences Center, in Seattle, may have found a new role for insulin, one that affects everyone: It may be the long-sought-after weight-regulation trigger in the human brain.

Drs. Stephen Woods and Daniel Porte, Jr., along with graduate students David McKay and Elizabeth Lotter, have completed a four-year study using baboons that shows that increased levels of insulin in the brain cause the animals to eat less. That, they say, means there's a weight-regulating system in the brain that uses insulin as the trigger.

"We now know something about what regulates body weight," Dr. Porte says. When a person's weight rises above normal, insulin levels in the blood increase. This eventually increases the insulin level in the cerebrospinal fluid surrounding the brain. Insulin receptors in the brain detect that rise and tell the weight-regulating mechanism, and the person feels less desire to eat. Weight drops back to normal.

Can all this help fat people? Possibly. "This *might* be manipulated in a therapeutic sense," Porte notes, adding that obesity is often a symptom of other problems.

McKay suggests that an artificial form of insulin might someday be introduced into the brain fluid of some overweight people, triggering the weight-regulating system into making them eat less. — J.D.

Appetite trigger. A four-year study showed that baboons ate less and lost weight when the insulin levels in their brains increased.

UNDERWATER TRAFFIC JAMS

First, cars choked the highways. Next spacecraft cluttered the exosphere. Now remote-controlled machines are creeping along the ocean floor in growing numbers.

Traffic jams of submersibles may someday be an unfortunate reality. The number of unmanned vehicles alone has increased tenfold.

In the last five years unmanned, remotely operated vehicles (ROVs) have proliferated. Offshore oil and gas drilling and potential large-scale seabed mining have led companies in many nations to make sophisticated machines that can maneuver in areas too risky for divers or manned underwater craft.

A Japanese ROV creeps along the sea floor like a mechanical crab, digging trenches and laying cable. A British ROV inspects deep-water welds in offshore oil-rig supports. One of the earliest ROVs, a U.S. Navy model, lifted a submerged hydrogen bomb 869 meters from the sea bottom off the coast of Spain in 1966.

The National Oceanographic and Atmospheric Administration says there are about 300 ROVs, a more than tenfold increase in five years. Experts say those numbers could dramatically increase with expanded offshore exploration. While the seas are large, most of the craft would be concentrated in areas of high commercial value. Result: traffic.

— Stuart Diamond

Development of a Project

1. *Enthusiasm*
2. *Disillusionment*
3. *Panic*
4. *Search for the guilty party*
5. *Punishment of the innocent party*
6. *Fame and honor for the nonparticipants*

— Anonymous

CONTINUUM

FIREWHEEL

For a few minutes this summer a green moon will light up the night sky. Slightly larger than our real moon, this artificial green one will actually be a big cloud of barium.

Part of an international experiment called Firewheel, the green moon will materialize when a European satellite scatters canisters of barium gas 56,000 kilometers above the equator. As the canisters explode, the sun's rays will begin ionizing the gas, turning it a pale green.

It will be the first time scientists can directly observe magnetic field lines in this area of the earth's magnetosphere. The barium, like the aurora borealis closer to Earth, will literally paint the magnetic lines, making them visible.

In addition, a small satellite, designed by scientists at the University of California at Berkeley, will fly through the cloud and measure both the energy changes in the barium and the flow of plasmas (hot ionized gases).

Valuable information about hot plasmas may be gathered, but the green moon is essentially an exploratory, fact-finding effort and only one part of a larger experiment coordinated by Germany's Max Planck Institute for Extraterrestrial Physics.

The exact date for this astrophysical sky show is dependent on weather conditions, but when it happens, it should be visible across the entire United States shortly after sunset.

—Jane Bosveld

"Time is the longest distance between two places."
—Tennessee Williams

Scientist fits hardware into a small University of California satellite that will fly through Firewheel's green moon of barium gas.

WOMEN AT ZERO G

A merger of the women's movement and the space program is raising some interesting dilemmas and uncertainties. Because of the space shuttle, which will carry both men and women aboard, NASA is reexamining some of its routine operations.

For example, research indicates that the shifting of blood and fluid balance during menstruation, without the tug of Earth's gravity, could cause some concern, according to Jerri Brown, of the Johnson Space Center, in Houston.

No one yet knows, Mrs. Brown says, whether the body can deliver the menstrual flow to the cervix by contractions alone, or whether a tampon can adequately absorb the flow.

However, Mrs. Brown, who has analyzed a wide range of female human factors, concludes, "No major problems so far have been identified or are expected that would preclude females from venturing into space."

But she recommends a closer attention to women's bodies in the design of space vehicles: Body size, posture, reach, and particularly strength needed to operate equipment and hatch doors call for new criteria when mixed space teams fly.

How about accessories for Madam's orbital boudoir? Leisure bras are in, while girdles are out.

This is one of several findings reached by Brown in surveying 22 female astronaut applicants. Women astronauts prefer a bra that offers light control with stretch to accommodate zero-g effects and the rougher launch and landings. Girdles are to be left back on Earth. They restrict and alter blood flow in the gravity-free environment.

Female astronaut in training: Long hair and girdles are out.

Removal of leg and underarm hair is basically cultural. Female respondents could tolerate seven days of hair growth, although half would call for shaving provisions on a 30-day mission.

Long, flowing hair may be out of place on space treks: It might get caught in scientific equipment or air locks. Long hair has a tendency to float free in zero g, as it does in a swimming pool.

—Leonard David

"The trouble with some self-made men is that they worship their creator."
—Anonymous

SOLAR PAR

It's a beautiful, sunny day for golf and you're not doing badly, considering your handicap. You're on the green in three, and if you sink the putt, you'll break your record. Better yet, if you

A well-placed shadow can cut a stroke off your handicap.

sink the putt, someone else has to buy the drinks when you get to the clubhouse.

You give the ball a tap. It rolls straight for the cup, then stops, teetering on the very edge. Your buddies begin to snicker. You smile and hold up your hand to indicate the shot is not over. You position yourself so that your body shades the ball from the sun. Fifteen seconds go by. Thirty. After a minute there is a little movement at the hole and the ball drops into the cup.

What happened? Perched on the edge of the hole, there is nothing holding the golf ball back but a few blades of grass. In the direct sunlight the metabolism of the grass is active; the blades are stiff. When the sunlight is blocked, the metabolism slows and the grass "relaxes." Unsupported, the ball rolls into the cup. And someone else buys the drinks. — Nick Engler

REUSABLE FILM

Thanks to the soaring price of silver, a key ingredient in many photographic processes, the price of film and photochemicals has taken quantum leaps in recent months.

However, help for shutterbugs may be arriving from the USSR. According to an article in *Soviet Weekly*, scientists at Kishinev University, in Moldavia, have developed a reusable photographic film.

The new film is made from thin layers of thermoplastic. This plastic becomes light-sensitive when an electric current is passed through it. You snap the picture with the current on, then wait for a negative to develop. If you don't like the picture, simply heat the thermoplastic to remove the image and shoot it again. — N.E.

MAGNETIC SMOG

High-speed trains may be subjecting their passengers, and others, to subtle behavior effects and even causing them to fall asleep. Among those affected are our leaders in Washington, if a Stanford University researcher is correct.

Radio scientist Anthony Fraser-Smith has discovered that such train systems as San Francisco's Bay Area Rapid Transit (BART) and the Washington, D.C., Metro expose people up to 160 kilometers away to "magnetic smog."

The third rail of such systems, says Fraser-Smith, acts as a huge antenna that broadcasts ultra-low-frequency radiation from 10 Hz to 0.001 Hz. "I don't know that your brain can distinguish between what BART is putting in your head and the signals it is producing itself," says Fraser-Smith.

"Studies have shown human reaction time is longer when people are exposed to 0.2 Hz fields, of which BART is a strong source. The Russians have done a lot of work on this and speak of these ultra-low frequencies as 'biologically active.' They may make people feel drowsy and produce slight changes in the blood. I think they confuse the brain a little bit. It thinks it should be asleep.

"I've done about all I can to measure the fields here and point out that they're present. I haven't had much success in interesting anyone to monitor the effects. But I think it should be a priority concern. The Washington Metro system is similar to BART, and we have all those important people there exposed to this." — A.M.

"Since I do not foresee that atomic energy is to be a great boon for a long time, I have to say that for the present it is a menace. Perhaps it is well that it should be. It may intimidate the human race into bringing order into its international affairs, which, without the pressure of fear, it would not do."

— Albert Einstein, 1945

BART: The highly charged third rail can act as a gigantic antenna, slowing down people's reaction time and even putting them to sleep.

CONTINUUM

POLLUTION BANK

In a small Maryland laboratory a few dozen samples of frozen liver tissue presage a new era in the

Chemist removes samples from liquid-nitrogen freezer.

study of pollution. They are the start of what is hoped will be a national bank of living tissue, to be compared over time to pinpoint environmental changes.

Until now, toxic-chemical concentrations in living tissue have been recorded on paper. But, as better detection methods uncover new chemicals, there is no way to find out whether—or how much—their levels have changed: The original samples no longer exist.

The national bank would enable scientists to go back to older, frozen samples and directly compare tissues in different geographic regions, both for existing and newly discovered heavy metals and toxic chemicals. "This would produce a better scientific basis for public policy questions and also help find out whether environmental laws are doing any good," says Gail Porter, of the National Bureau of Standards (NBS).

NBS scientists early this year began a five-year pilot program, funded largely by the U.S. Environmental Protection Agency. The NBS's Maryland lab will house about 30,000 samples from four groups: liver, because it stores pollutants; wheat or rye, which are staples of the American diet; oysters or mussels, which concentrate marine pollutants; and lichens or moss, which concentrate airborne pollutants.

Tissue samples are frozen to −190°C. Scientists hope to develop techniques to store the samples up to 100 years. — S.D.

THE MIDAS TOUCH

Nuclear physicists have turned the dream of alchemists into reality. They have changed base metal into gold. But there's a catch: You need $15 million worth of equipment.

Actually, Dr. David J. Morrissey and his colleagues weren't trying to beat the high prices of the international gold market when they bombarded bismuth with large, highly charged atomic nuclei traveling close to the speed of light. They were simply carrying out basic research in nuclear science, trying to find out how the nuclei of atoms are held together.

The team of chemists had certain advantages over their medieval predecessors. They had a giant atom smasher, BEVALAC (Billion Electron Volt Synchrotron/Linear Accelerator), at the University of California's Lawrence Berkeley Laboratory, and they used bismuth instead of lead, which of course had been preferred in olden times.

"Bismuth is, atomically speaking, nearer to gold," said Dr. Morrissey. "Like gold, it has only one isotope that is stable against radioactivity. And bismuth has only three more protons in its nucleus than gold." Morrissey said he was "pretty sure" his team would succeed.

In three experiments, using from 4.8 billion up to 25.2 billion electron volts, the scientists beamed argon-40 and neon-20 isotopes, stripped of electrons in order to accelerate them, at bismuth metal foil targets.

Morrissey reported that, although no new and unknown isotopes of gold were observed, improvements in experimental techniques might produce some. The actual transmutation of bismuth to gold was described by Morrissey as "trivial."

Equipment costing more than $15 million would be required to produce less than one billionth of one cent's worth of gold. "This obviously is not a cost-effective way to make gold," he concluded. — Phyllis Wollman

"Problems worthy of attack/
Prove their worth by hitting back."

—Piet Hein

The BEVALAC: Machinery costing more than $15 million is required to produce less than one billionth of one cent's worth of gold.

LAST LEAF

Endangered species of animals have acquired hordes of protectors in recent years. There are dozens of organizations willing to fight for bald eagles or snail darters. But what about endangered plants?

Literally hundreds of plant species stand in imminent danger of losing their last leaf. Unfortunately, there's little publicity for this side of the endangered-species problem.

For example, a recent Oregon State University study indicates that almost 400 plant species in that state alone are in danger of extinction. And in Arizona, Colorado, New Mexico, Texas, and Utah, 21 species of cactus are being uprooted to the point of extinction by collectors and dealers.

Other U.S. flora in danger of feeling the last rays of sunlight on their chlorophyll include Texas wild rice, the Virginia round-leaf birch, the Hawaiian wild broad bean, the furbish lousewort, and the Contra Costa wallflower.

Ironically, yet another plant about to die off is the Santa Barbara liveforever.

—J.D.

"Human beings are members of the only species that possesses the capability to interfere with its own growth."
—Fritz Perls

TALKING WHEELCHAIR

Victims of cerebral palsy or stroke and other disabled persons who cannot speak clearly, if at all, now have a helpful new gadget: a talking wheelchair.

Developed at Stanford University's Children's Hospital and funded by the NASA Ames Research Center, both in California, the device features a computer word processor and a speech synthesizer mounted on a wheelchair.

Users tug a switch or shift a joystick or peck at a typewriter keyboard—depending on how well they can move—to string together words and sentences on a video screen. Then they activate a mechanical voice to deliver the digital message in a monotone like the computer HAL's in the movie *2001*.

The device could confer artificial speech on the 1.5 million Americans—such as deaf-mutes—who cannot speak understandably.

The computer stores 925 widely used words, follows 600 grammatical rules, talks at varying speeds, pitches, and volumes, and can even be programmed to stockpile complete sentences and phrases for later use. An expert operator can turn out, impromptu, as many as 30 words a minute.

Six patients tested the device for a week. An elderly stroke victim, who otherwise wrote what she wanted to say on note pads, talked over the telephone—via the prosthesis—with her family. A young woman with a neurological disease, contracted three months after bearing a son, was able to speak to that son, now five, for the first time. Her first words: "Kevin, put your pajamas on right now!"

—Robert Brody

"'Not quite proved' in mathematics is like 'not quite pregnant' in biology."
—Howard Pattee

Included in the long list of endangered plants are 21 species of cactus, which are being uprooted to extinction by collectors.

Equipped with a word processor, a computer, and a voice out of an SF movie, the talking wheelchair gives speech to the handicapped.

CONTINUUM

PLIGHT OF THE PANDA

An eminent American scientist is rushing to China to equip that country's giant pandas with radios. His object is to keep the species alive.

The giant panda, one of the world's most popular animals and the national symbol of China, is the focus of a newly formed committee of Chinese and Western scientists. In recent years pandas, which probably do not number more than 1,000, have been starving to death because of a mass die-off of bamboo, a major component of their diet.

The American delegation to the committee will be headed by George B. Schaller, director of the New York Zoological Society's Center for Field Biology and Conservation. He will be the first Westerner since the 1930s to visit Sichuan (Szechwan) Province, one of three provinces where pandas live.

According to Schaller, surprisingly little is known about the giant panda, a black-and-white relative of the bear. "The first thing to do is find out where they are and how many there are," he said. After that, he added, free-ranging pandas may be fitted with small radios that enable researchers to track and study the animals without seeing them. Without radios, it would be difficult to observe individual pandas repeatedly because they live in mountains with densely forested lower slopes.

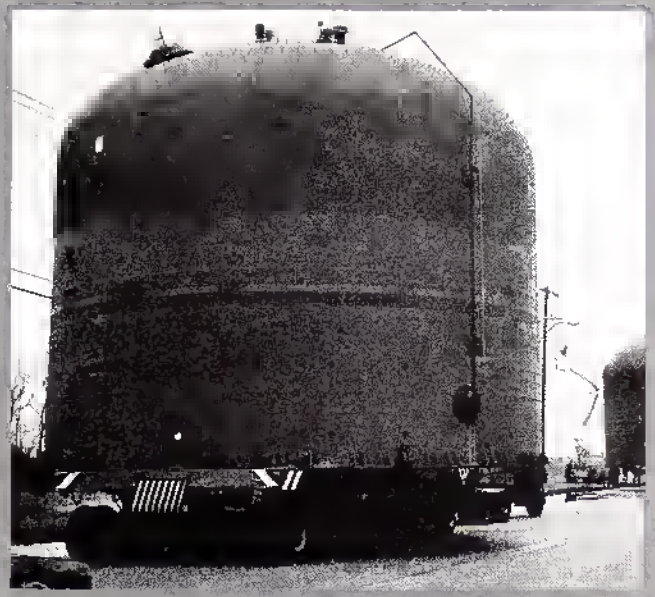
The die-off of bamboo that is affecting giant pandas apparently occurs about once every 100 years. The plants bear seed before they die, but the seedlings take several years to mature. Since the bamboo began to die several years ago, the carcasses of at least 140 starved pandas have been found. How pandas managed to survive previous bamboo failures isn't known, but they may have done so because they had a wider range. In the Pleistocene, or Ice Age, pandas were found in many parts of China and also in Burma. Their range may have been wider in historic time, too.

The giant panda, which can grow up to two meters in length and weigh as much as 140 kilograms, is an animal with no close genetic relatives. Its closest relative is the red panda, a small, cat-sized creature of a different genus that lives in various parts of Asia. Previously believed to be a kind of raccoon, only recently have scientists come to think the giant panda is related to the bear. —Barbara Ford

Help is on the way for the giant panda, shown here munching away on its favorite bamboo, which is currently dying off en masse.

"It has to do with: Are we good painters, good sculptors, great poets? I mean, all the things that we really venerate and honor in our country and are patriotic about. In that sense, this new knowledge has all to do with honor and country, but it has nothing to do directly with defending our country except to help make it worth defending."

—Robert R. Wilson, director of Fermilab, in response to Senator John Pastore, who had asked how nuclear accelerators contribute to national defense, 1969



Looking like a scene out of Attack of the Giant Killer Snails, *a 74-ton sodium tank for the Clinch River Breeder Reactor inches its way down a road to its storage site in Memphis, Tennessee. The Clinch River plant will use three such sodium tanks, the largest ever built in the United States (each holds 310,000 liters) for a breeder reactor.*

WINNERS

Sports' emerging heroes reach pinnacles of power through science

BY SUSAN MAZUR

He knifes into the water, instantly bringing his body to the perfect position for speed. The movement comes naturally to him now, after hours of practice under calibrated computer control.

Reaching forward for his first stroke, he gauges the depth of his kick. The computer said he kicked too deeply. Now he is careful to execute the movement perfectly. His stroke enters the water at the optimum angle. His arms pump easily against the pressure he experienced hundreds of times in the computer weight room.

Straining to match the computer's perfection, he knows he is moving faster than anyone thought possible.

"Computer training transcends mere strength, freeing a swimmer to achieve his full potential," says Robert Schleihauf, who trains

"We can surpass all physical limits. Computer training enables us to see movement beyond human perception."

swimmer on a computer system at Teachers College, Columbia University. "With the computer we can evaluate each of a swimmer's movements and eliminate all the tiny flaws that the swimmer doesn't notice and the coach can't see. Even Olympic-caliber swimmers can improve their times significantly through our computer training techniques."

Schleihauf uses a computer system devised by Dr. Gideon Ariel, the former Israeli discus hurler, who is now director of computer sciences and mechanics for the U.S. Olympic Committee. "The human eye cannot quantify human movement," he says. "The important things in performance—the timing, the relative speeds of dozens of limb and body segments, the changes in center of gravity—all must be measured, weighed, and compared scientifically to be of any use."

The future of sport, says Dr. Irv Dardik, of the Council on Sports Medicine, rests in the hands of science. Coaches will become scientists. Computers, behaviorism, biomechanics, and genetics will help create perfectly tuned athletes. New tools will usher in an age in which human perceptions are too limited to train human bodies.

"How can the human eye tell whether an athlete has turned his shoulder a degree too far to the left or stopped a centimeter short when releasing the ball?" Ariel asks. "In fact, it can't. But the computer can evaluate many elements at once."

Ariel's better-than-human eye begins with a camera that shoots an athlete's motion at up to 10,000 frames a second. These high-speed images are projected onto a screen over an array of 20,000 extremely sensitive microphones. A special sonic pen is used to trace the athlete's position in each photo frame. Microphones pick up the signals and relay them to a computer that animates a stick figure on a video screen. The stick figure simulates a full sequence of athletic movements, which can be frozen at any point for observation.

Golf swings and other movements can reach perfection with computer techniques (above), but sweat and desire, as shown by boxer Chuck Wepner (left), are essential for athletic excellence.

Ariel uses this setup to determine an athlete's center of gravity, velocity, acceleration, direction, angle of attack, and force. It gives him a fixed image of the relationship of every part of an athlete's body to every other part at all stages of movement, allowing the tiniest flaws in technique to be studied and corrected without guesswork.

"When a swimmer is working out," he says, "the coach can't tell whether his hand motion produces the most thrust, whether his starting dive is as effective as possible, whether the angle of his arm entry generates the least resistance. We study the athlete in the gym. We test him in flumes with stress pulleys attached so that we can gauge the force generated by many different movements. We create a pattern through the computer of the best possible series of motions. This we compare with the swimmer's performance in the pool. Only then can the coach know exactly where the swimmer is working to best advantage and where he isn't. Before the advent of computers, coaches were merely guessing."

The emerging science of sport will work with athletes' minds as well as with their bodies. It encompasses programs from broad social schemes to minute manipulations of behavior. It is "a holistic approach, utilizing psychology as well as physiology, sociology, and medicine," according to Dr. Marvin Clein, of the Human Performance Laboratory, in Denver.

"Already," declares Dr. Jakow Bielski, a psychologist at City University of New York, "it is common today among athletes, regardless of class, to assume that performance is about twenty percent physical and eighty percent mental. This understanding alone typifies a new kind of emerging athlete, one who stands much removed from the inherently physical athlete of time not so far past."

Dr. Bielski points to the mental edge that lifted the American hockey team over the physically superior team sent by the USSR in last winter's Olympic Games as an example of the power of behaviorism in athletics. "However, the real impact of this shift to a more mental, systematic approach to sports," Bielski says, "is yet to be seen. The future athlete will implement behavior-control advancements so that even spontaneity will be controlled."

Right now scientists are looking for ways to assist athletes in eliminating mental blocks and integrating the workings of their minds and muscles. Dr. Richard O'Brien, of Hofstra University, in New York, is using hypnosis and relaxation techniques to help athletes conquer suppressed fears. Dr. O'Brien worked with boxer Duane Bobick, who had the disastrous habit of "freezing up in the first round." O'Brien, employing hypnosis, discovered a seething caldron of fears and insecurities that paralyzed the fighter in the ring. He took Bobick through a treatment of 20-minute tension-relaxation sessions. First, he'd tell the fighter to tense his muscles, then to relax them. Next he'd go on to internalized routines, with Bobick relaxing himself by concentrating on soothing thoughts. Finally, Bobick grew so adept at willing himself to relax that he overcame his first-round handicap completely.

Dr. Clein is working on systems to improve athletes' "muscle memory." He believes the athlete rises or falls on a kind of intelligence that Clein calls fluid. O'Brien, a zealous supporter of Clein's ideas, says,

"There are no sports that I know of where you are really cognitively involved. There are no thinking sports. Sports are fluid motion, muscfe memory. The proper response has to come from muscle memory because Lord help you if you try to think aboul anything athletic." Cfein probes the body tor its information storage-and-retrieval potential much as a neurologist probes the nerves. Clein links athletes to a host of measuring systems with electrodes, noting the range of muscle-nerve responses as the athletes make athletic choices.

Bielski takes a slightly ditterent position. "The ability to switch from the fluid state to the cognitive and vice versa is where the real power fies," he says. "This is what separates the supple, successful Roger Staubach-type athlete from the stitf Duane Bobick-type. The power of switching marks the great performer. The ability to alter the game plan by quick-thinking strategy, as well as by recalling a learned repertoire of techniques. To follow rushes of confidence with the knowledge of when to stop and ask, 'What am I doing? What is my opponent doing? Whal is going on in this situation?' All without ever losing sight of the point, successful performance."

Even the physicaf side of sports science will have a positive mental impact on athletes. New training systems that achieve better conditioning for athletes also generate enormous confidence because ot their scientific precision and efficiency. The athletes are not simply in better shape, they know they're in better shape, and so they perform without worry.

Ariel's Wifson-Ariel 4000, which the Daflas Cowboys will use this season, actuafly puts the computer in charge of the player's training. Ariel's unit monitors hydraulic fifts that function like barbelfs, except that their pressure can be fine-tuned to maximize a player's workout. A physical profife cassette is made for each athfete, relating his strengths, weaknesses, body peculiarities, and fitness goals. The computer uses this profile to adjust the pressure, speed, and duration of the 4000's drills. It can, tor instance, help an athlete build up a postsurgical knee by presenting it with the most appropriate amount of pressure each day, whife keeping the other leg trom going soft by challenging it with the full training weight. This individual programming, Ariel asserts, cuts down on training time, gives the athlete confidence in his training regimen, and alfows coaches to train each part ot an athfete's body to absolute specifications for his particular task.

"The 4000 gives you a lot more information," Ariel says, "and it tells you how you're progressing. It will fet you know it you're lazy or if you should try harder. It'll even remind you if you haven't paid your gym dues lor the month."

The Hilton hotel chain, Ariel claims, is thinking about putting 4000's in all its health clubs so that travelers can get perfect workouts through their computer cassettes, no matter where they may be.

The next trontier, envisioned by Arief, wifl be three-dimensional computer simufations of athletic motion. Not exactfy holograms, these images will be 3-D views projected on a two-dimensional screen. Like computer-generated engineering perspectives, they will give the illusion of three-dimensionality.

"By using a hologram, you'd really see the figure in 3-D, utifizing optical prisms and things like that," Ariel says. "And we wifl see that in the near future, no question about it. You'll be able to step right into a hologram to simulate the movements of an Olympic champion. We are working on that now."

Arief's work may represent sports' next destination, but quite a few trainers and athletes haven't gotten there yet. They prefer training techniques that, while new, aren't as far out as prancing stick figures. The most popular among these is the Cybex machine, a spin-off from *Skylab* that has found wide acceptance with professional baskelball and football teams.

"The willingness to use new technologies and ideas represents the coming wave in coaching that many believe will soon bridge the gap between scientific needs and athletic habits."

The Cybex uses a technique called isokinetics, which means that the harder you push, the more resistance you meet, like running your hand through water. The *Skylab* astronauts used the device to keep fimber in their confined space. Now earthbound athletes have found it an adaptable and effective conditioning tool.

Bob Reese, trainer of the New York Jets, uses the Cybex as part ot his predraft physical to determine an athlete's range of joint motion and muscle strength. By pinpointing gaps in muscle strength—such as more than a 10 percent strength difference between legs—the Cybex can weed out injury-prone players and train their weak muscles into playable form.

Mike Saunders, trainer and physicaf therapist for the New York Knicks, lauds the Cybex's flexibility and precision. "We can set it for revolutions per minute or degrees per second, and an athlete can work out at all various speeds. We can calculate how many foot-pounds of torque are produced by a muscle group. What's important is to get a base line that serves as the comparison levef of an athlete's basic health or injury. If he is injured, we can work him out on the Cybex, comparing body strength trom session to session until he's matched his base line. Then we know he's fit. Then he can play."

According to Saunders, Cybex is doubly beneficial: ft offers physical advantages of swift, controlled training and the confidence of mind that one's training is doing what it's supposed to do.

"In the case of Hollis Copeland [of the Knicks]," Saunders says, "we used the Cybex to increase the strength of certain muscles while we rehabilitated his slightly injured ligaments. We used knee flexions and extensions at slow speed both to build up the old injury and to make a new injury less likely. Later we compared his left leg to his right leg in terms of strength and then looked at the original base line. Hoflis saw his charl and was satisfied that he was okay to play. The fact that an athlete can see his own readout from the Cybex is another important feature of the machine and of the athlete's heafing process."

Some sports diehards still stick with the most modest advance in training gear, the Nautilus, a contraption that links the common types of weightlifting movements into a single unit. The athlete can perform all his exercises in one place without fear ot dropping weights and without the need for spotters to litt and lower barbelfs.

"I don't believe in anything but the Naulilus," says boxing manager Dave Wolf. "I am aware of other sorts of machines, bul the Nautilus is the only one I'll use."

One reason why some athletes lag behind in using new training methods, Saunders thinks, is that they feel fike human guinea pigs, under the thumb of jargon-babbling scientists who don't really care about their problems. If information from scientific testing could be made more intelligible to athletes, Saunders believes, more would use it. "It is, after all, not the computer that does the work," he notes, "but the people who interpret the information. And that information could really help athletes, or it coufd just help some doctor publish articles in journals that few people would understand."

Some athletes' skepticism about new methods has hardened into downright disbelief. "f just don't believe Ariel's system is possible," states Mike O'Shea, owner of the New York Sports Training Institute. Kayaker Steve Kelly, one of O'Shea's athletes, adds, "I think it's hogwash. Most of the findings in my event could have been deduced by simply watching movement with the naked eye." Ariel counters that Kelly and other kayakers didn't work with the computer long enough to obtain significant results.

Others point out that, no matter how effective new training machines may be, they still can't overcome the enormous intluence of mental states on sports figures. In some cases, in fact, the machines can be mentally devastaling for an athlete.

Consider bike racer Paul Deem, who won a Pan-American Games gold medal while still a teen-ager, then captured an

CONTINUED ON PAGE 91

VODKA & ROSE'S

Vodka smooths out
in the limelight.
4 parts Vodka, 1 part Rose's.®

Rose's Lime Juice*
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FICTION

She really was a nice little girl, but she sure knew how to burn a guy up

FIRESTARTER

BY STEPHEN KING

"Daddy, I'm tired," the little girl in the green pants and the red blouse said fretfully. "Can't we stop?"

"Not yet, honey."

He was a big, broad-shouldered man in a worn and scuffed-looking corduroy jacket and nondescript brown twill slacks. He and the little girl were holding hands and walking up Third Avenue in New York City, walking fast, almost running. He looked back over his shoulder, and the green car was still there, crawling along slowly in the curbside lane.

"Please, Daddy. *Please*."

He looked at her and saw how pale her face was. There were dark circles under her eyes. He picked her up and set her in the crook of his arm, but he didn't know how long he could go on like this. He was tired, too, and Charlie was no lightweight anymore.

It was five-thirty in the afternoon, and Third Avenue was clogged. They were crossing streets in the upper Sixties now, and these cross streets were both darker and less populated, but that was what he was afraid of.

His arm was getting tired, and he switched Charlie to the other one. He snatched another look behind, and the green car was still there, still pacing them, about half a block behind. There were two men in the front seat and, he thought, a third in the back.

What do we do now?

No money. That was maybe the biggest problem, after the actual fact of the men in the green car. You couldn't do anything with no money in New York. People with no money disappeared in New York. They dropped into the sidewalks, never to be seen again.

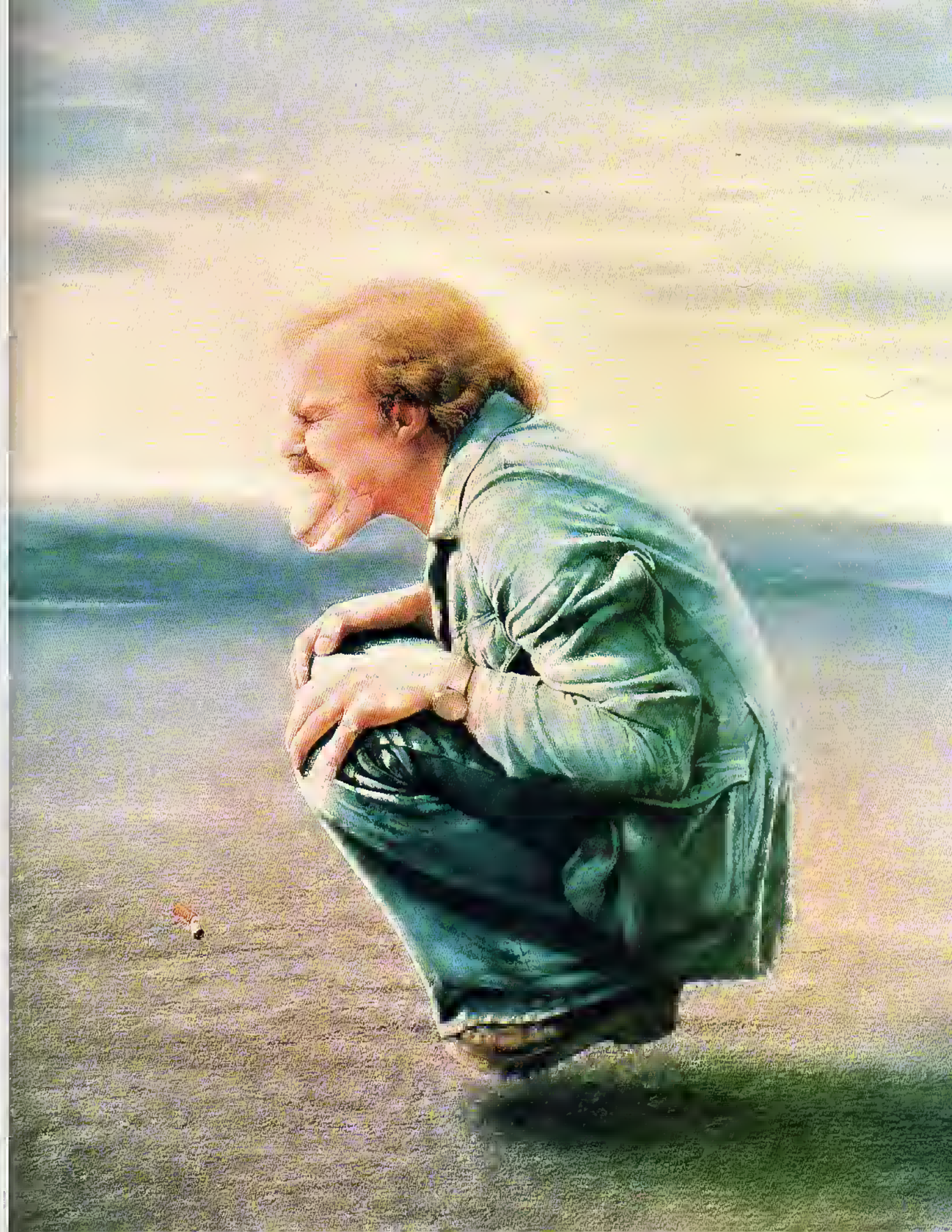
He looked back over his shoulder and saw the green car was a little closer, and the nervous sweat began to run down his back and his arms a little faster. If they knew how little of the push he actually had left, they might try to take him right here and now.

He had gone into the bank at noon because his radar had been alerted—that funny-hunch feeling that they were getting close again. There was money in the bank, and he and Charlie could run on it if they had to. And wasn't that funny? Andrew McGee no longer had an account at the Chemical Allied Bank of New York, not personal checking, not business checking, not savings. They had all disappeared into thin air, and that was when he knew they really meant to bring the hammer down this time. Had all of that really been only five and a half hours ago?

But maybe there was a tickle left. Just one little tickle. It had been nearly a week since the last time—that presuicidal man at Confidence Associates who had come to the regular Thursday night counseling session and then begun to talk with an eerie calmness about how Ernest Hemingway had committed suicide. And on the

Part one of a two-part excerpt.

PAINTING BY GOTTFRIED HELNWEIN



way out, his arm casually around the pre-suicidal man's shoulders, Andy had given him a push. Now, bitterly, he hoped it had been worth it. Because it looked very much as if he and Charlie were going to be the ones to pay.

One little tickle, he prayed. *That's all, God, just one little tickle. Enough to get me and Charlie out of this jam.*

They were coming up on Seventieth Street. The light was against them. Traffic was pouring across and pedestrians were building up at the corner in a temporary bottleneck. And suddenly he knew this was where the men in the green car would take them. Alive if they could, of course, but if it looked like trouble . . . well, they had probably been briefed on Charlie, too.

Maybe they don't even want us alive anymore. Maybe they've decided to just maintain the status quo. What do you do with a faulty equation? Erase it from the board.

He would have to try for that tickle. There was just nothing else.

They reached the waiting pedestrians at the corner. Across the way, DON'T WALK held steady and seemingly eternal. He looked back. The green car had stopped. The curbside doors opened, and two men in business suits got out. They were young and smooth-cheeked. They looked considerably fresher than Andy McGee felt.

He began elbowing his way through the clog of pedestrians, his eyes searching frantically for a vacant cab.

"Hey, man—"

"For Christ's sake, lella!"

"Please, mister, you're stepping on my *dog*—"

Then Andy saw a vacant cab.

"Taxi! Taxi!" he yelled, flagging madly with his free hand.

Behind him, the two men dropped all pretense and ran.

The taxi pulled over.

"Hold it!" one of the men yelled. "Police! Police!"

A woman near the back of the crowd at the corner screamed, and then people began to scatter.

Andy opened the cab's back door and handed Charlie in. He dived in after her. "LaGuardia! Step on it," he said.

"Hold it, cabbie. Police!"

The cabdriver turned his head toward the voice, and Andy pushed—very gently. A dagger of pain was planted squarely in the center of his forehead and then quickly withdrawn, leaving a vague focus of pain, like a morning headache—the kind you get from sleeping on your neck.

"They're after that black guy in the checkered cap," he said to the cabbie.

"Right." the driver said, pulling serenely away from the curb. They moved along East Seventieth.

Andy looked back. The two men were standing alone at the curb. The rest of the pedestrians who had been waiting to cross wanted nothing to do with them. One of the two men took a walkie-talkie from his belt and began to speak into it. Then they were gone.

"That black guy," the driver said, "whaddy do? Rob a liquor store or somethin', you think?"

"I don't know," Andy said, trying to think how to go on with this, how to get the most out of this cabdriver for the least push. Had they got the cab's license number? He would have to assume they had. But they wouldn't want to go to the city or state cops, and they would be surprised and scrambling for a while at least.

"They're all a bunch of junkies, the blacks in this city," the driver said. "Don't tell me. I'll tell you."

Charlie was going to sleep. Andy took off his corduroy jacket, folded it, and slipped it under her head. He had begun to feel a thin hope. If he could play this right, it might possibly work.

"I've changed my mind," Andy said.

"I'm going to give you a five-hundred-dollar bill to take me and my daughter to Albany. Okay?" Andy stuck the bill into the cabbie's hand, and as the cabbie looked at it, Andy pushed . . . hard.

"Take us to Albany, please."

"Where?" The driver stared at him in the rear-view mirror. "Man, I can't take a fare to Albany. You out of your mind?"

Andy pulled out his wallet, which contained a single dollar bill. He thanked God that this was not one of those cabs with a bulletproof partition and no way to contact the driver except through a money slot. Open contact always made it easier to push. He had been unable to figure out whether that was a psychological thing or not, and right now it was immaterial.

"I'm going to give you a five-hundred-dollar bill," Andy said quietly, "to take me and my daughter to Albany. Okay?"

"Jeeesus, mister—"

Andy stuck the bill into the cabbie's hand, and as the cabbie looked down at it, Andy pushed . . . and pushed hard. For a terrible second he was afraid it wasn't going to work, that there was simply nothing left, and he had scraped the bottom of the barrel when he had made the driver see the nonexistent black man in the checkered cap.

Then the feeling came—as always, accompanied by that steel dagger of pain. At the same moment his stomach seemed to take on weight and his bowels locked in sick, gripping agony. He put an unsteady hand to his face and wondered whether he was going to throw up . . . or die. For that one moment he *wanted* to die, as he always did when he overused it.

"Gee, mister, I don't know—"

Which meant he thought it must be trouble with the law.

"The deal goes only if you don't mention it to my little girl," Andy said. "The last two weeks she's been with me. She has to be back with her mother tomorrow morning."

"Visitation rights," the cabbie said. "I know all about it."

"I was supposed to fly her up."

"To Albany? Probably Ozark, am I right?"

"Right. Now I'm scared to death of flying. I know how crazy that sounds, but it's true. Usually I drive her back up, but this time my ex-wife started in on me, and . . . I don't know." In fact, Andy didn't know. He had made the story up on the spur of the moment, and now it seemed to be headed straight down a blind alley. Most of it was pure exhaustion.

"Five hundred bucks to skip a plane ride," the driver mused.

"It's worth it to me," Andy said, and he gave one last little shove. In a very quiet voice, speaking almost into the cabbie's ear, he added, "And it ought to be worth it to you."

"Listen," the driver said in a dreamy voice, "I ain't furnin' down no five hundred dollars. Don't tell me. I'll tell you."

"Okay," Andy said, settling back. The cabdriver was satisfied. He wasn't wondering about Andy's half-baked story. He wasn't wondering what a seven-year-old girl was doing visiting her father for two weeks in October with school in. He wasn't wondering about the fact that neither of them had so much as an overnight bag. He wasn't worried about anything. He had been pushed.

Now Andy would pay the price.

Andy sat with his head back and his eyes closed. The headache was coming, coming, as inexorable as a riderless black horse in a funeral parade. He could hear the hoofbeats of that horse in his temples. *Thud . . . thud . . . thud.*

On the run. He and Charlie. He was thirty-four years old. Until last year he had been an instructor of English at Harrison State College, in Ohio. Harrison was a sleepy little college town. Good old Harrison, the very heart of mid-America. Good old Andrew McGee, fine, upstanding young man.

Thud, thud, thud. Riderless black horse coming on, coming on, and coming on—behold, a black horse.

Andy slept.

And remembered.

The man in charge of the experiment was Dr. Wanless. He was fat and balding and had at least one rather bizarre habit.

"We're going to give each of you twelve

young ladies and gentlemen an injection," he said, shredding a cigarette into the ashtray in front of him. His small, pink fingers plucked at the thin cigarette paper, spilling out neat little cones of golden-brown tobacco. "Six of these injections will be water. Six of them will be water mixed with a tiny amount of chemical compound that we call Lol Six. The exact nature of this compound is classified, but it is essentially a hypnotic and mild hallucinogenic. Thus, you understand that the compound will be administered by the double-blind method, which is to say, neither you nor we will know until later who has gotten a clear dose and who has not. The dozen of you will be under close supervision for forty-eight hours following the injection."

Andy had been put onto the experiment by Quincey Tremont, the fellow he had roomed with in college. Quincey knew that Andy's financial situation was precarious.

"How would you feel about a quick two hundred?" Quincey asked.

Andy brushed long, dark hair away from his green eyes and grinned. "Which men's room do I set up my concession in?"

"No, it's a psych experiment," Quincey said. "Being run by the Mad Doctor, though. Be warned."

"Who he?"

"Him Wanless, Tonto. Heap big medicine man in-um psych department."

"Why do they call him the Mad Doctor?"

"Well," Quincey answered, "he's a rat man and a Skinner man both. A behaviorist. The behaviorists are not exactly being overwhelmed with love these days."

"Oh," Andy said, mystified.

"Also, he wears very thick little rimless glasses, which make him look quite a bit like the guy who shrank the people in *Dr. Cyclops*. You ever see that movie?"

Andy, who was a late-show addict, had indeed seen it, and he felt on safer ground, but he wasn't sure he wanted to participate in any experiments run by a professor who was classified as (a) a rat man and (b) a Mad Doctor.

"They're not trying to shrink people, are they?" he asked.

Quincey laughed heartily. "No, that's strictly for the special-effects people who work on the B horror pictures," he said. "The psych department has been testing a series of low-grade hallucinogens. They're working with the U.S. Intelligence Service."

"CIA?" Andy asked.

"Not CIA, DIA, or NSA," Quincey said. "Lower profile than any of them. Have you ever heard of an outfit called the Shop?"

"Maybe in a Sunday supplement."

Quincey lit his pipe. "These things work in about the same way all across the board," he said. "Psychology, chemistry, physics, biology . . . even the sociology boys get some of the folding green. Certain programs are subsidized by the government. What does our intelligence branch want with low-grade hallucinogens? Who knows? I don't. You don't. Probably they don't, either. But the reports look good in

CONTINUED ON PAGE 105

To sell the American Dream,
Madison Avenue charts
new frontiers in consumer science

PSYCHOGRAPHICS

BY BIBI WEIN

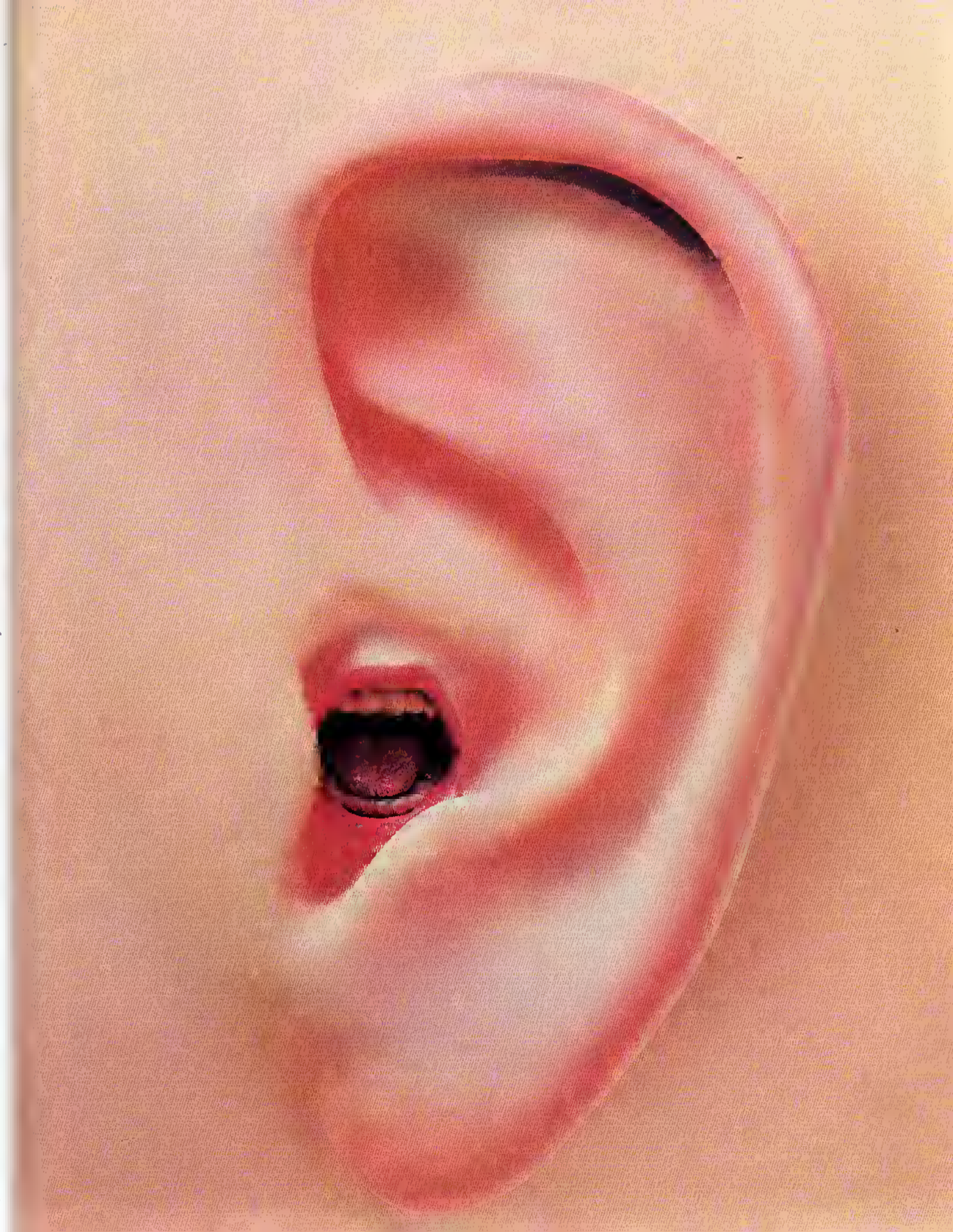
Messages, nearly 2,000 a day, batter the average adult. About twice as many as we received ten years ago. If you don't believe it, when you get up tomorrow, start counting. How many commercials do you hear on the radio? How many billboards do you pass on the way to work? How many messages grab you as you pass the newsstand? And you haven't even opened up your mail yet. Or visited a store. Or turned on the TV.

Two thousand messages a day! Word messages. Picture messages. Populated by reflections of ourselves—of who we think we are, or who we'd like to be. Delivered by messengers (Joe DiMaggio, O. J. Simpson, Farrah Fawcett—name your favorites) whom it has been determined—and there are statistics to prove it—we credit with being on the inside track to the truth.

We all know that ads don't just spring full-blown from the brows of agency "creatives." But most of us remain unaware that, as the noise of competing messages swells to an uproar, the content of advertising is increasingly determined by the findings of scientists. Specialists in a broad range of scientific disciplines are probing our attitudes, our bodies, and our minds to discover how best to sell us the American Dream.

Marketing research has always centered on one basic question: What does the consumer want? That focus is now deepening; the consumer mind is being dissected to discover what makes it tick. Ever more sensitive measures have been designed to penetrate the censors in our brains and to tap social values and thinking modes we seldom verbalize. Advertising-campaign strategies in the Eighties will reflect the discoveries of laboratory-based researchers who, in many instances, are learning more about the consumer than the consumer knows about himself.

No one claims he can scientifically predict or produce "a purchasing response," but many are trying. Dr. Sidney Weinstein, a neurophysiologist, is one of the most respected scientists known to be working with



advertisers today. Dr. Weinstein claims his is the only commercial laboratory that performs sophisticated brain wave analyses; others moonlight out of university and government facilities.

"By determining the proportion of beta waves to alpha waves that a person registers while viewing an advertisement," Weinstein explains, "one can measure the degree to which the individual has been 'activated'—presumably in the direction of purchasing the product." Weinstein monitors his subjects on an EEG oscilloscope, which measures both beta activity and the comparative intensity of left- and right-cerebral-hemisphere response. Right-brain activity indicates a response to images and shapes; left-brain action denotes attention to verbal concepts. With such data, Weinstein begins to shape a profile of how a consumer responds to various elements of an advertisement.

Which elements are working? Who is the best spokesman for the product? Which of several suggested themes is best? Should I advertise on radio or TV or in print, and in what order? Do I need 60 seconds, or will 30 do, at about two thirds the cost? Weinstein has found that, in some instances, ten seconds—cheaper still—is most effective.

Among Weinstein's clients are all three television networks, a dozen advertising agencies, and manufacturers of packaged foods, beverages, cosmetics, cars, and appliances. Most clients remain publicly nameless because they swear Weinstein to secrecy, although he can't understand why.

When asked to appear on the popular TV show *20/20*, Weinstein sought permission to air commercials for which he had provided research. He was perplexed when a major agency declined. "A thirty-second spot on *20/20* probably goes for one hundred twenty thousand dollars, and they turned down a chance to get one free."

Brain wave studies, whose potential in advertising has barely surfaced, deal with immediate physiological response. Other, more elaborate consumer profiles are derived from existing methods that, when combined with modern science, produce minutely detailed evaluations.

Psychographic studies, also known as attitudinal research or the study of life-style and values, query our activities, interests, and opinions in lengthy precoded questionnaires that are administered to thousands of people and are then subjected to statistical analyses. Inherent in this approach is the assumption that if you ask enough innocuous questions in enough different ways, basic feelings will become clear.

The most ambitious psychographic study carried out so far is probably the Leo Burnett life-style study completed in the fall of 1979. Nearly 4,000 questionnaires—120 pages for women, 70 for men—were hand-delivered. There was a 35 percent return. "A mountain of data," sighs Burnett's Charles Stannard, whose job it was to make sense of it all.

"I don't know what people were consuming before these studies began in the late Sixties, but now they are consuming leisure," Stannard reports.

"Blue-collar homes are chock-full of the latest gadgets. Some of these gadgets are very fancy. In upper-class homes we're seeing such luxuries as the two-hundred-dollar tennis racket. It's not going to make their game any better. People are buying wishes and promises. Selling the technical aspects of the quality racket would be less effective than selling 'the smasher.' Yet what we keep hearing in our data is that people want to return to a simpler life."

The Burnett data also corroborate something other observers have noted: We are now more interested in consuming experiences than in consuming things. That's one reason why life-style research, costly and involved as it may be, is now being used in some form by about 50 percent of marketers. To sell merchandise as experience is a complex proposition; more than ever before, advertisers need to know what we think, what we actually want to do with our time, and how, in detail, the fragments of our culture differ from one another.

"The same principles that Moskowitz used to come up with the ideal potato chip are now being refined by commercial science to optimize the image of political candidates."

To this end, life-style research "sorts us into piles," as Seymour Banks, media vice-president of Leo Burnett, puts it. "But no one has yet arrived at definitive psychographic types. We divide up very differently, depending on who is dividing us and for what purpose. Broad stereotypes—the happy housewife, the organization man, the pleasure-seeking man, and so on—may be sufficient. Or we can be broken down into very small but profitable segments to target specific products."

Product-specific psychographics are designed to measure the appeal of a dog food that costs more than any current brand or the potential for a metropolitan daily in the suburbs. Soap manufacturers may seek "a market opportunity" for still another soap, to be targeted at people who are dissatisfied with available brands.

Establishing a market for a new product is not an easy job. To arouse the consumer's interest, everything from a product's color, texture, and smell to its price and packaging must be considered. Psychophysicist Howard Moskowitz uses computer modeling to create a quick, marketable formula from these intangibles.

An associate of Weston Group, Inc., Moskowitz describes himself as a sensory engineer. Basically, he creates the best possible consumer products by systematically varying several ingredients, getting reactions from consumer test panels, and developing equations that modify the ingredients to suit the consumers' reactions.

"What we come up with is an actual perfect recipe, which we weigh against costs. We then calculate how much we lose in consumer acceptance by making the product cheaper for the manufacturer or by making it more expensive for the consumer." Moskowitz can formulate a shampoo with "the optimum amount of perfume" or, for that matter, discover the sensory properties of the best shampoo for a particular life-style target. He can also test its image and packaging for greatest "acceptance." The cost of such a program is considerably less than "rolling out" real products for sampling by selected targets in the real world—and results come far faster.

"Product qualities," says Jack Lewis, president of Weston Group and formerly an executive at Procter & Gamble, "are defined by the consumer as she or he perceives them, not by me sitting here in my office. The traditional test-marketing process takes years. With computers we can do it in months."

Sensory engineering currently has greater impact in advertising than brain wave studies because it is more supple and detailed. Up until now brain wave studies have indicated only "activation" and "interest," but more details from the oscilloscopes lie just over the horizon.

Weinstein feels their use will grow because they fulfill a fundamental need of advertisers.

"If people have nothing to hide, you can trust your interview data. You don't need brain waves," he says. "But if there is any question of morality, the chances are, you're not going to get the truth." People have all sorts of attitudes that they cannot communicate verbally, but these nonetheless dominate their behavior.

To expose nonverbal signals, Dr. Weinstein isolates a brain wave that occurs within 300 milliseconds of a stimulus. Called the Cortical Evoked Potential, the technique may soon register the full range of human emotions. "Feelings," he says, "may be reflected in the electrical impulses of the brain, not in the sense that there's a love wave or a hate wave, but in a more general, connotative sense. We could tell you on a scale of one to five whether a brain wave is positive, slightly positive, neutral, slightly negative, or negative. It's complicated, and it would be very expensive, but we could do it."

The scientist likes to cite a rejected study as evidence that his work is more accurate than traditional research. "A year or so ago

CONTINUED ON PAGE 96

CHILDREN OF POSEIDON

A colony by the sea rides the wave of the future

BY KENNETH JON ROSE

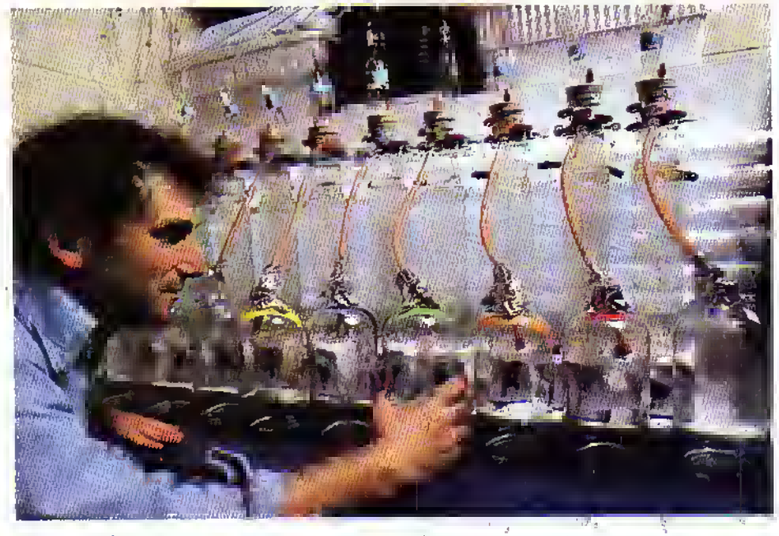
There is an alien civilization living peacefully on the southwestern tip of Cape Cod, Massachusetts. But you won't see it if you go there. It is set amid quaint New England houses and modern buildings at a charming place by the sea called Woods Hole.

Like some Hollywood set, the weathered, wooden cottages along the road to the village, the old stone library, the bank on the corner with its framed windows and whitewashed sides crowding the walkway, and the small, red-brick post office are all a clever deception.

Concealed behind the facade, hidden from the outsider, is a technological colony devoted to the marine environment. But perhaps even more than that, Woods Hole is a technological community of the future.

With its white-painted sides blistering from the sun and the salt air, the house on School Street is an obvious tip-off. Although it may look like any other Colonial house, the rooms inside are devoid of canvas lamp-

PHOTOGRAPHS BY MALCOLM KIRK



shades and rocking chairs. Instead, there are computers. The fluorescent-lit interior is crammed with them.

A bearded college type is reading a list of numbers to his associate sitting beside the squat Sigma 7. The statistics, gathered to compare the makeup of fish populations with the efforts of fishermen on the Georges Bank off the coast of Nantucket Island, could well predict the types and sizes of fish available for food in the years ahead. Another program digests data taken over the past 30 years to plot the relationship between changes in the temperature of the sea's surface and short-term climate fluctuations. What finally emerges is a clearer understanding of the overall climatological picture. Nearby a third program formulates data about the different layers of the earth's interior—information that could prove invaluable to the fledgling science of earthquake prediction.

Like the Computer Center, Woods Hole is a strange mix of ultramodern science and familiar, down-home surroundings. Yet that kind of luxation might be the vogue of the future, and this waterside village could be leading the way.

Woods Hole's deceptiveness lies in its personality. Politically a part of the town of Falmouth, the village serves as a summer resort for the affluent and as a port for the ferryboats that travel to the islands of Martha's Vineyard and Nantucket, immediately to the south.

To the rest of the world, Woods Hole is synonymous with science of the Olympian kind—so much so that it has been called the mecca of marine science by its admirers. The opportunity to study at this center is as sought after by most scientists and graduate students as is tenure at the Institute for Advanced Study, in Princeton, or membership in Washington, D.C.'s Cosmos Club. "If you've got to study the ocean," one scientist said, "this is the place to be."

Walk into Fishmonger's Cafe, the local restaurant near the drawbridge overlooking the channel that connects Eel Pond with Great Harbor. Go past the hippies in their torn jeans and granny dresses seated by the doorway and you begin to understand that Woods Hole, more than a research institute, is a state of mind.

The man wearing a red, short-sleeved shirt and tan shorts is casually talking to his friends about the effects of chlorine on larval fish. There is a rumble of laughter in one corner. A group of men and women with some sort of exotic marine animal printed in ink on the backs of their shirts are chatting about the last fish tow in the Pacific. "You counted *how many* isopods in that stomach?" somebody at the counter shouts. A man with fluffy white hair puts down his avocado-and-Muenster sandwich, leans over to a woman sitting nearby, and says, "Your sections of the perikaryon were lovely." He accidentally drops his napkin to the floor. Instead of mayonnaise smudges, there are light pencil scribblings of a complex molecule.

The importance of Fishmonger's Cafe to the Woods Hole community was evident a year and a half ago when the landlady found that the restaurant was permitting people who had no money to eat there free and work off the price of the meal afterwards. She closed the place down. Immediately the residents raised enough money to pay off the restaurant's debt and bought a new Fishmonger's Cafe across the street.

Just opposite Fishmonger's, squeezed against muddy, boat-stuffed Eel Pond, stands the Marine Biological Laboratory (MBL). This cluster of concrete and old,

Ocean biologist Joel Goldman inspects phytoplankton cultures (upper left); fish samples netted in salt marsh for pollution analysis (right).

red-brick buildings attracts top-notch biologists the way Switzerland attracts skiers. At last count, some 30 Nobel laureates and a few National Medal of Science winners had passed through its portals. Selman Waksman, the man who discovered a cure for tuberculosis, worked at MBL. So did Ivan Pavlov, the Russian physiologist who conditioned dogs to drool: so did James Watson, one of the researchers who broke the DNA code. And you can still see eighty-six-year-old Albert von Szent-Gyorgyi strolling around the place in jacket and dungarees.

Szent-Gyorgyi, who won the 1937 Nobel Prize for his discovery of vitamin C and the Albert Lasker Award for the first practical explanation of heart-muscle contraction, is still raising eyebrows for his controversial work on the "bioelectronic" theory of cancer. The eminent scientist has been tinkering in his small lab in MBL's Lillie Building with the idea that cancer begins when something goes haywire with the electrons within the cell, not with the larger molecules themselves, which has been the main thrust of cancer research. To a great majority of cancer researchers, Szent-Gyorgyi's theory doesn't hold up, chiefly because no solid evidence has yet been advanced to support his claim. But the Nobel laureate doesn't seem discouraged. People have always been skeptical of his theories, until they're proved correct.

Theories are a specialty at the Capt'n Kidd, a tavern nearby, which serves the same communal purpose as Fishmonger's but for a younger generation of scientists. The decor—old, faded life preservers on the walls and shark jaws close to the register—is typically touristy. The conversations are not.

During the summer the bar is usually jammed with college vacationers from Falmouth resort beaches who listen to the blaring jukebox while downing a few beers. But dispersed among this sea of singles, bibulous jokesters, and other beach persons are pockets of researchers, fishermen, and students, discussing some of the things textbooks haven't gotten around to printing.

Farther up the street sits the Woods Hole Oceanographic Institution (workers here like to call it *whoo-ee*, after its initials, WHOI). Behind the staid brick walls various departments divide up the seas like one great tub of cheese. Here biologists study the effects of pollution on the sea bottom and do research on how sewage can be used productively by salt marshes. Chemists learn why various elements move through the ocean and how radioactive particles are distributed in the water. Geologists and geophysicists examine continental drift.

Joel Goldman, at WHOI's department of biological oceanography, is investigating how the drifting plants of the ocean, called phytoplankton, subsist in their environment. By regulating certain things like temperature, Goldman is able to "farm" mass cultures of algae. Potential uses, Goldman thinks, could be anything from protein-packed seaburgers to the development of an important energy source; harvesting and fermenting algae to make methane.

Like the MBL, Woods Hole Oceanographic is not without its alumni. Many scientists serve there on one advisory board after another. Robert A. Frosch, for example, left a position at WHOI to become the director of NASA.

Science at Woods Hole actually began with Spencer Fullerton Baird, an assistant secretary to the Smithsonian Institution, who went to the Cape looking for a place to study population changes among food fishes. Impressed with the little village, he established the country's first government marine laboratory, in 1875. For Baird, the area was ideal. Not only was it the nexus between warm currents of the Gulf Stream and cold waters of the Labrador Current, but it was free from the contamination of river effluent. The combined effect creates a huge diversity of marine forms that furnish ample specimens for study.

> *"If a creature with three legs landed in the village of Woods Hole and wanted lab space, as long as its science was reproducible, nobody would care."*

What was once a peaceful community of farmers and fishermen gradually filled with academicians, a special breed of people as dedicated to their work as they were to their surroundings. This zeal provided the glue that kept the scientists together. Such camaraderie might have disturbed the established locals, but the relationship was pleasantly symbiotic. Some of the older researchers remember a story about a young reporter who came to the village to ask the fishermen how they liked having all the scientists around. One replied, "Used to be that when we caught a dogfish shark, we'd just have to throw 'em back in the water. Now we sell 'em."

The large Victorian structure where Baird once worked has long since been torn down. In its place, pushed against the water's edge at the corner of Water and Albatross streets, is a blocky laboratory called the Northeast Fisheries Center of the National Marine Fisheries Service. Local residents, though, simply call it the Fisheries. Key information about fish in the northwestern Atlantic is gathered at this facility, everything from the effects of pollution on fish larvae to the size and life histories of fish in a particular area. Jon Gibson is the information officer at the facility and is rather proud of the Fisheries' record. Besides being the first fisheries research lab established in the world, the Fisheries was the leader in fostering international cooperation in oceanographic research. Gibson says, "We had the first bilateral agreement with the Soviet Union for studying the world's oceans."

That kind of record has put the Fisheries in one of the best positions to view the fate of the oceans and of the fishing industry. Because of the increased costs of energy, Gibson sees a revolution occurring in marine commerce and management within the next 20 or 30 years. "It will cost more for other nations to come to this country and fish," he says. "Foreign fishing in our waters will almost certainly decline."

This is good news for the U.S. fishing industry. But Gibson envisions an even brighter future when sophisticated computer tracking and sampling systems will transform the oceans into vast aquatic supermarkets, ready to be fished in the most efficient and environmentally sound way. "Even now we have estimates of all of the major fish stocks in the northwest Atlantic Ocean," Gibson declares. "It seems possible that these estimates will become more accurate as our technical knowhow increases."

Hidden in the tree-choked section of the village, just a mile up the road, is still another institution, the U.S. Geological Survey. There scientists study the structure of rocks on the bottom of the ocean, producing information that has been used by various companies to locate oil and natural gas deposits on the eastern coast of the United States. USGS assistant branch chief Bill Green says that this process is not as easy as it sounds. "There's no tool yet that will allow you to directly determine whether there is oil or gas in a rock. Somebody has to go out and drill the holes."

When four separate, powerful institutions, each with its own mandate, end up living in an area only the size of a football stadium, there's bound to be a little pushing and shoving. Quarrels have, in fact, flared up between these facilities because of something as insignificant as a parking space. But for the most part the bickering is almost brotherly. This relationship may be the reason why certain flare-ups haven't been more serious. Gibson explains, "It's important for us to have the scientists of WHOI and MBL around for peer review. And we, in turn, can provide them with peer review by saying how practical or how logical something they're doing is. We complement each other very well."

What do the scientists of Woods Hole do with their time when they're not busy dissecting the world's oceans? Many spend their off hours sailing, or fishing with lures scientifically selected for their effective-

ness. Others are cooks or musicians. Goldman likes to spend his time in the garden near his home, where his algae-growing techniques are applied to tomatoes and beans. "Whatever knowledge I have based on my job," he says, "is transferred to my outdoors activities."

This kind of attitude saturates this town like the warm salt air blowing off the ocean. It's seen in the plays, in the Scottish and ballet dancing, in the drawings displayed by the artists' guild. But perhaps it's best seen in the interpersonal relationships among people who live at Woods Hole. As is not so at other seaside communities, unorthodox behavior is accepted as casually as the tide. One scientist said, "If a creature with three legs landed in the village and wanted lab space, as long as its science was reproducible, nobody would care."

Nothing shows this more clearly than the yearly Woods Hole May Festival and its notorious Black Dog Contest. In any other village such a contest might generate as much excitement as the Dewey decimal system. But not in Woods Hole. The object, of course, is to choose the best-looking dog, the ugliest dog, or anything lying in between. The unusual part of the contest is that most of the contestants are not black dogs. In fact, cats have been entered, not to mention ducks with black ears, invisible black dogs on leashes, and even people, the same people who have discovered how the world works.

If Woods Hole's new elite think that they have staked out a utopia for the future, they may be deluding themselves. The scientists at Woods Hole compose only a small minority of Falmouth Township's 21,000 residents. Wait for the drawbridge, separating the mainland from the village, to raise its gray belly and see the rust in Woods Hole's shining armor.

On the underside of the bridge, sprayed in orange paint, are the words GET OUT OF OUR HOLE; TOURISTS GO HOME. The work of juveniles. The paint is faded as if it had been there for a long time. It is the most blatant sign that something is wrong. But if the signals are obvious, the causes, some researchers say, are not.

A few years ago Emperor Hirohito of Japan planned an unofficial visit to the village to discuss his field of marine biology with a scientist at WHOI. Apparently, though, Falmouth got wind of the visit and arranged for the emperor to tour a few of the more historical spots in the area, one of them being the home of Katharine Lee Bates, writer of the song "America the Beautiful." When Emperor Hirohito arrived, he skipped through Falmouth proper and drove directly to Woods Hole. That day has not been forgotten by the folk of Falmouth.

Part of the problem lies with Woods Hole's international clout—a fact the town fathers are quick to realize. But also, being the major employer on the Cape, Woods Hole has economic clout. "Falmouth is quite dependent on the scientific institutions," says shop owner Bill Banks. "Not fully dependent, but enough so that if they moved away, there'd be hell to pay." Nevertheless, with all of its political influence, the village takes little advantage of it. "There have been times, though," Banks adds, "when they wished they could have."

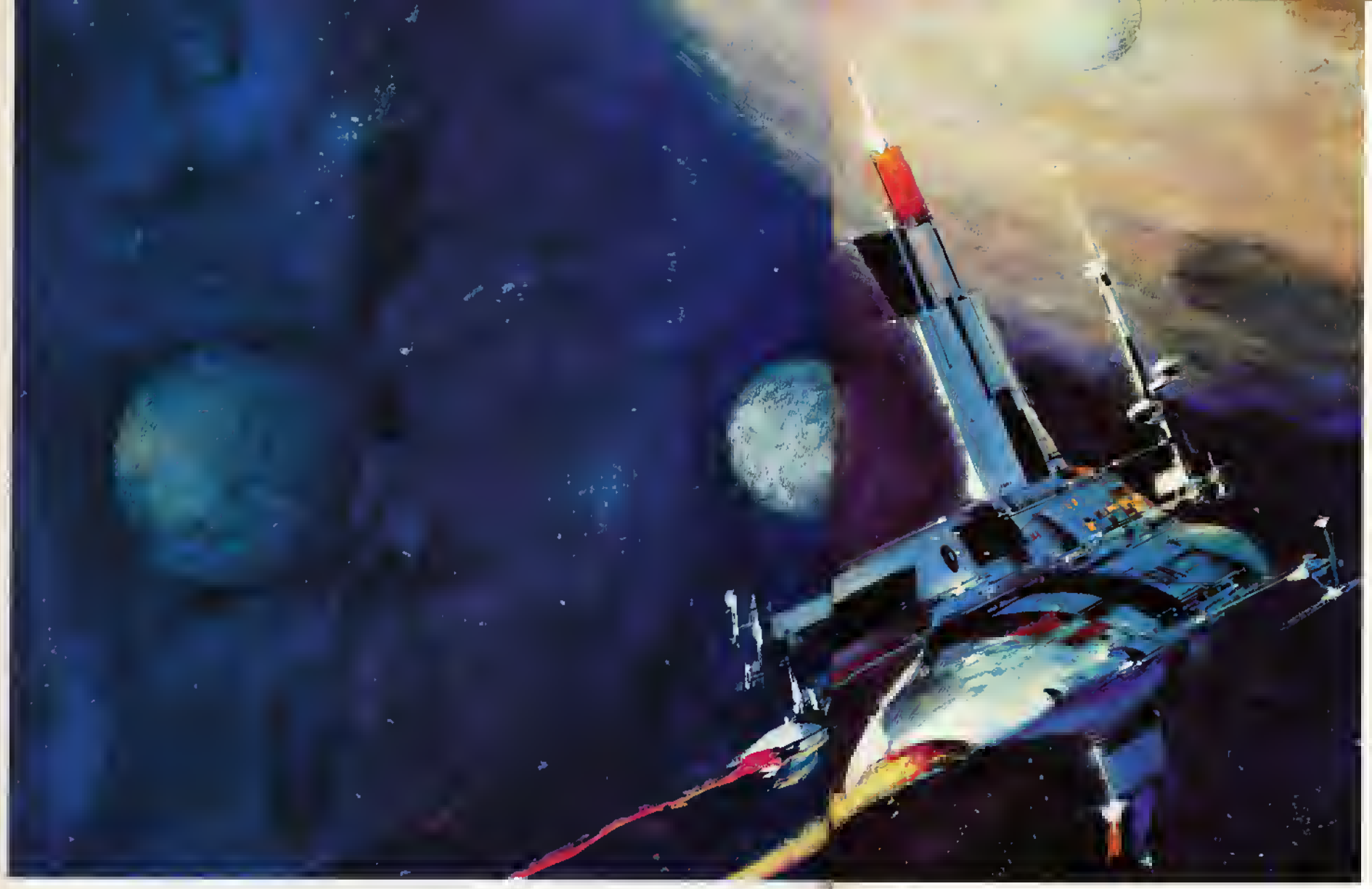
There are other problems. Every summer since 1913, the Woods Hole School of Science program has been a thorn in Falmouth's side. Perhaps the most unusual school of its kind in the country, the classes stress learning by observation. Designed for children between the ages of seven and fifteen, the school occasionally holds classes at nearby ponds and beaches. The teachers are chosen by the mothers, not for the amount of educational experience they have, but for how well they know their subject and can teach it. The school is perhaps the one nonscience building in Woods Hole that acts to bring families closer together, making this science-based community warm and human.

The courses are college-level stuff, not watered-down electives. Ornithology is ornithology, and not bird watching. There is also entomology, vertebrate zoology, ecology, and biological illustration. Without the pressures of grades or tests, the children learn the scientific names of the specimens they pick up on field trips, write reports, and have class discussions about what they've found. But they are not child protégés plucked from genetically controlled test-tube environments. They are normal kids, and some of these children come from neighboring towns, but most of them are the children of scientists.

The tensions and hidden jealousies these children are exposed to when they enter the mainly middle-class, blue-collar Falmouth school system are understandable. One biologist remembers when the students in a class at a Falmouth school were told to bring in pictures of animals they thought were unusual. Two Woods Hole students brought in the real thing: a specimen taken from a mile below the ocean's surface. Another investigator recalls wrestling with a particularly difficult problem his son brought to him from class. His solution: "I just sent him to the fellow down the hall. He did the original work the chapter was based upon."

The exposure to science comes naturally to the members of the scientific colony, but it tends to alienate the rest of the population. If Woods Hole has proved anything, it has demonstrated that scientific ivory towers do turn yellow and that they have a weak side that can't always be defended. No human-built technological colony will be perfect. Even Woods Hole is not without its share of divorce, alcoholism, and tension between neighbors. "We have our problems as everyone else does," said one Woods Hole researcher. "That's the one thing that our science may never be able to solve. Unfortunately," he added, "human frailties come with the species." ∞

"Would you folks prefer the American plan, the European plan, or the Amoebic Dysentery plan?"



FICTION

Freud had to solve the problem – or he'd shrink into the dream cube

SIGMUND IN SPACE

BY BARRY N. MALZBERG

Freud walks the anterior corridors of the *Whipparly VI*, meditating on the situation. The captain is a manic-depressive. The navigator has a severe oedipal block, which is gradually destroying him; he is unable to attain orgasm, even though the mechanicals are skilled and devoted. The hydroponics expert, a grim woman in her nineties, is manifesting advanced symptoms of dementia praecox, and at least half the crew, by all standards of early-twentieth-century Vienna (which must of necessity be his touchstone), is neurotic to the point of dysfunction: depressive reactions, conversion hysteria, bizarre sexual urges, and the like. Clearly, the administrators must have been desperate to place him on this vessel. Freud hardly knows where to begin. What can he do? What psychotherapeutic techniques (which by definition require patience) can possibly prevail in this emergency? If Freud were not so wondrously confident of his abilities, so protectively despairing, he would be most undone. As it is, professional detachment threatens descent into woe. He must be careful.

The rhythm of his pacing increases. Freud risks greedy little glances at the huge screens glinting around him, looking at

PAINTING BY JOHN BERKEY

the disorder of a constellation, a smudge of stars. Here in the late twenty-fifth century space exploration is not routine; the *Whipperly VI* is on a dangerous mission to the hitherto-unprobed Vegans. The view of the universe from a distance of so many light-years from Vienna is astonishing. Freud would not have dreamed that such things were possible. Furthermore, he would not have dreamed that as technology advanced, the common neuroses would prevail. Of course, that was foolish. The pain, the schism, the older ironies would prevail. This crew exhibits symptoms that would not have astonished anyone at a routine Tuesday presentation.

Freud shrugs. He reaches inside his vest pocket for a cigar and match, lights the cigar with a flourish, watches smoke whisk into the ventilators as he turns in the corridor and then returns to the small cubicle that the administrators have given him as office space. The desk is littered with papers, the wall with diplomas. Freud feels right at home. Within their limits the administrators have done everything possible to grant him credibility and a sense of domain. If he is unable to cope, he knows they will only blame him more. *Well*, he thinks, *well, what they decide will be done. I will be shrunken again and replaced in the dream cube. It will be many centuries before I receive another assignment. But then again I will have no knowledge, and therefore my entrapment will be in their estimation, not mine. The last time I had an assignment was in the early twenty-second century: the madman on Venus who thought he was a vine and threatened to cut off the dome respirators. I didn't handle that too well and got derricked for centuries. But here I am again and none the worse for it. Their sanctions exclude me.*

This thought impels him toward his next act, which is to use the communicator on his desk to contact the captain and summon him to his office. Of all the technological wonders of this time, the communicator is a simple instrument, reminiscent of the telephone of his era. Freud wonders idly whether they have given him this to make him feel at home or whether the twenty-fifth is simply a century less sophisticated than the slick and dangerous twenty-second, which he remembers so vividly. He also thinks, while waiting for the captain, of his old rivals Adler and Jung.

Doubtless that miserable pair have already been summoned and failed on this case. There is grim satisfaction in knowing this. But he would have hoped to have been reconstructed more often. Two jobs in the twenty-first, three in the twenty-second before that disaster on Venus, and now this. Not good. Not good at all.

Well, there is nothing to be done about that. Here he is, and here the responsibility for the mission reposes. The captain enters his cabin, a slender, ashen-faced man, dressed in fatigues but wearing a full dress cap. His aspect is impatient but restrained. Like all on board, he has been given the strictest orders to comply with Freud's procedures. The administrators cannot control the fate of the mission, but they can abort it, tearing the ship apart at the touch of a light-year-distant incendiary beam. The captain knows this. He sits across from Freud, his hands on his knees, and while staring at him earnestly, his eyes slowly ignite under Freud's gaze. "We're going to take over those Vegans," he says, unprompted. "You know that, of course."

"Of course," Freud says sympathetically.

"They're a green humanoid race, primitive but with the potential for technological advance. They're hostile and barbaric. We're going to wipe them out while we still have time. I have plans," the captain says shakily. "I have enormous plans."

"Of course you do," Freud says. He puffs on the cigar with what he hopes resembles a gesture of serenity. "Why do you feel you must destroy the Vegans?"

"Because otherwise in a generation they'll have spaceships and atomic devices and will destroy *us*," the captain says. "Don't worry, I'm completely in control. I'm a highly trained man."

"The last time I had an assignment was in the early twenty-second century: the madman on Venus who thought he was a vine and threatened to cut off the dome respirators. I didn't handle that too well."

Freud has read the capsule reports prepared by the administrators. Of course there are no Vegans at all; there are three silicon-based planets circling an arid star. In five centuries of space probes, life has never been found on these planets. "I know you're trained," Freud says. "Still, I have a question, if I might ask it."

"Please ask it," the captain says hoarsely. "I am prepared to deal with any questions."

"That's an important quality, to be sure. Now, what if it happened to be," Freud says gently, "that there are *no* Vegans?"

"There *are* Vegans. Several hundred million of them. I'm going to wipe them out."

"Yes, yes, but what if there aren't? Just to speculate—"

"You're just like the rest of them," the captain says, his face mottling. "You damned toy, you *reconstruct*. You're just like the rest. Don't humor me. I'm going to save the universe. Now I have to get back to my bridge. I must prepare for the deadly cancer-causing Vegan probes, which could encircle us at any moment."

"How long have you felt this way?" Freud essays mildly as the captain stalks out. Freud sighs and stubs his cigar on the desk and then stares at his diploma for a while. Then he summons the navigator.

The navigator shows considerably less effect than the captain but, after some gentle probing, discloses that his mother is aboard the ship, stowed away in one of the ventilators and whispering thoughts to him of the most disgusting nature. He has always hated and feared his mother, and that is why he enlisted in the service. But she will not leave him alone—he was a fool to think that he could escape. Freud dismisses him and turns to the hydroponics engineer, who tells him bitterly that he, too, is already affected virally with an insidious disease, which the captain has been seeding into the units. Machine or otherwise, Freud is as doomed as the rest, but at least he can try to keep up his strength. She offers him some celery. After she leaves, he gnaws it meditatively and talks to some selected members of the crew. They believe the officers to be quite mad; in self-defense they have turned to bestial practices. Here at last Freud finds some professional respect—they are impressed that the administrators would send another famous psychoanalyst as reconstruct to superintend their voyage. They hope that he does better than Adler and Jung, who worked together and succeeded only in boring them with lectures in the assembly hall on mass consciousness until the administrators, displeased, dwindled them and said that they would send a true practitioner, a medical doctor, in their place.

Freud sends the crew on their way and lights another cigar. The symptoms evinced are extraordinary, yet there is enough consistency in the syndrome for him to infer that the administrators have lied to him: *Everyone* on this ship has gone mad, and this is probably a consequence of the mission itself. Long probes—their stress, isolation, boredom, and propinquity—must tend to break down the crews. The administrators have called for him not because of special circumstances but because of *ordinary* circumstances. What they want him to do is to patch over matters in order that the mission may conclude. There has been much difficulty and expense; it would be wasteful and cruel to abort the mission so close to its end.

Freud stands, neatens his desk marginally, and returns to the corridor and his pacing. The welter of constellation now stuns and discommodes. Freud adjusts the angle of the windows so that he can evade them. Space, for an early-twentieth-century Viennese, is overwhelming; it must have less of an effect upon the custodians of the twenty-fifth, but several months in this environment would undo anyone, he thinks. The administrators have obviously tried to routinize the missions just as with the reconstructions they have routinized a qualified immortality. But in neither case

CONTINUED ON PAGE 98

ESSAY

A celebrated author relives the inspiration that gave birth to his epic tale of power and paradox

DUNE GENESIS

BY FRANK HERBERT

Dune began with a concept whose mostly unfleshed images took shape across about six years of research and one and a half years of writing. The story was all in my head until it appeared on paper as I typed it out.

How did it evolve?

I conceived of a long novel, the whole trilogy as one book about the messianic convulsions that periodically overtake us. Demagogues, fanatics, con-game artists, the innocent and the not-so-innocent bystanders—all were to have a part in the drama. This grows from my theory that superheroes are disastrous for humankind. Even if we find a real hero (whatever—or whoever—that may be), eventually fallible mortals take over the power structure that always comes into being around such a leader.

Personal observation has convinced me that in the power arena of politics/economics and in their logical consequence war, people tend to give over every decision-making capacity to any leader who can wrap himself in the myth fabric of the society. Hitler did it. Churchill did it. Franklin Roosevelt did it. Stalin did it. Mussolini did it.

My favorite examples are John F. Kennedy and George Patton. Both fitted themselves into the flamboyant Camelot pattern, consciously assuming bigger-than-life appearance. But the most casual observation reveals that neither was bigger than life. Each had our common human ailment—clay feet.

This, then, was one of my themes for *Dune*: *Don't give over all of your critical faculties to people in power, no matter how admirable those people may ap-*

PHOTOGRAPH BY NORMAN SEEFF

pear to be. Beneath the hero's facade you will find a human being who makes human mistakes. Enormous problems arise when human mistakes are made on the grand scale available to a superhero.

And sometimes you run into another problem.

It is demonstrable that power structures tend to attract people who want power for the sake of power and that a significant proportion of such people are imbalanced—in a word, insane.

That was the beginning: Heroes are painful, superheroes are a catastrophe. The mistakes of superheroes involve too many of us in disaster.

It's the systems themselves that I see as dangerous. *Systematic* is a deadly word. Systems originate with human creators, with people who employ them. Systems take over and grind on and on. They are like a flood tide that picks up everything in its path. How do they originate?

All of this encapsulates the stuff of high drama, of entertainment—and I'm in the entertainment business first. It's all right to include a pot of message, but that's not the key ingredient of wide readership. Yes, there are analogs in *Dune* of today's events—corruption and bribery in the highest places, whole police forces lost to organized crime, regulatory agencies taken over by the people they are supposed to regulate. The scarce water of *Dune* is an exact analog of oil scarcity. CHOAM *is* OPEC.

But that was only the beginning.

While this concept was still fresh in my mind, I went to Florence, Oregon, to write a magazine article about a U.S. Department of Agriculture project there. The USDA was seeking ways to control coastal (and other) sand dunes. I had already written several pieces about ecological matters, but my superhero concept filled me with a concern that ecology might be the next banner for demagogues and would-be heroes, for the power seekers and others ready to find an "adrenalin high" in the launching of a new crusade.

Our society, after all, operates on guilt, which often serves only to obscure its real workings and to prevent obvious solutions. An adrenalin high can be just as addictive as any other kind of high.

Ecology encompasses a real concern, however, and the Florence project fed my interest in how we inflict ourselves upon our planet. I could begin to see the shape of a global problem, no part of it separated from any other—social ecology, political ecology, economic ecology.

It's an open-ended list.

Even after all of the research and writing, I find fresh nuances in religions, psychoanalytic theories, linguistics, economics, philosophy, theories of history, geology, anthropology, plant research, soil chemistry, and the metalanguages of pheromones. A new field of study rises out of this like a spirit rising from a witch's caldron: *the psychology of planetary societies*.

Out of all this came a profound reevaluation of my original concepts. In the beginning I was just as ready as anyone to fall into step, to seek out the guilty and to punish the sinners, even to become a leader. Nothing, I felt, would give me more gratification than riding the steed of yellow journalism into crusade, doing *the book* that would right the old wrongs.

Reevaluation raised haunting questions. I now believe that evolution, or deevolution, never ends short of death, that no society has ever achieved an absolute pinnacle, that all humans are not created equal. In fact, I believe attempts to create some abstract equalization create a morass of injustices that rebound on the equalizers. Equal justice and equal opportunity are ideals we should seek, but we should recognize that humans administer the ideals and that humans do not have equal ability.

Reevaluation taught me caution. I approached the problem with trepidation. Certainly, by the loosest of our standards, there were plenty of visible targets, a plethora of blind fanaticism and guilty opportunism at which to aim painful barbs.

"You want absolute prediction? Then you want only today, and you reject tomorrow. You are the ultimate conservative. You are trying to hold back movement in an infinitely changing universe."

But how did we get this way? What makes a Nixon? What part do the meek play in creating the powerful? If a leader cannot admit mistakes, these mistakes will be hidden. Who says our leaders must be perfect? Where do they learn this?

Enter the fugue. In music, the fugue is usually based on a single theme that is played many different ways. Sometimes there are free voices that do fanciful dances around the interplay. There can be secondary themes and contrasts in harmony, rhythm, and melody. From the moment when a single voice introduces the primary theme, however, the whole is woven into a single fabric.

What were my instruments in this ecological fugue? Images, conflicts, things that turn upon themselves and become something quite different, myth figures and strange creatures from the depths of our common heritage, products of our technological evolution, our human desires, and our human fears.

You can imagine my surprise to learn that John Schoenherr, one of the world's foremost wildlife artists and illustrators, had been living in my head with the same images. People find it difficult to believe that John and I had no consultations prior to his painting of the *Dune* illustrations, which follow this essay. I assure you that the paintings were a wonderful surprise to me.

The Sardaukar appear like the weathered stones of *Dune*. The Baron's paunch could absorb a world. The ornithopters are insects preying on the land. The sandworms are Earth shipworms grown monstrous. Stilgar glares out at us with the menace of a warlock.

What especially pleases me is to see the interwoven themes, the fugue-like relationships of images that exactly replay the way *Dune* took shape.

As in an Escher lithograph, I involved myself with recurrent themes that turn to paradox. The central paradox concerns the human vision of time. What about Paul's *gift* of prescience—the Presbyterian fixation? For the Delphic Oracle to perform, it must tangle itself in a web of predestination. Yet predestination negates surprises and, in fact, sets up a mathematically enclosed universe whose limits are always inconsistent, always encountering the unprovable. It's like a koan, a Zen mind breaker. It's like the Cretan Epimenides saying, "All Cretans are liars."

Each limiting, descriptive step you take drives your vision outward into a larger universe, which is contained in still a larger universe ad infinitum, and in the smaller universes ad infinitum. No matter how finely you subdivide time and space, each tiny division contains infinity.

But this could imply that you can cut across linear time, open it like a ripe fruit, and *see* consequential connections. You could be prescient, predict accurately.

Predestination and paradox once more.

The flaw must lie in our methods of description, in languages, in social networks of meaning, in moral structures, and in philosophies and religions—all of which convey implicit limits where no limits exist. Paul Muad'Dib, after all, says this time after time throughout *Dune*.

Do you want absolute prediction?

Then you want only today, and you reject tomorrow. You are the ultimate conservative. You are trying to hold back movement in an infinitely changing universe.

The verb *to be* does make idiots of us all.

Of course there are other themes and fugal interplays in *Dune* and throughout the trilogy. *Dune Messiah* performs a classic inversion of theme. *Children of Dune* expands the number of themes interplaying. I refuse, however, to provide further answers to this complex mixture. That fits the pattern of the fugue: You find your own solutions. Don't look to me as your leader.

Caution is indeed indicated, but not the terror that prevents all movement. Hang loose. And when someone asks whether you're starting a new cult, do what I do: Run like hell. ∞

DUNE

Here the moon is your friend, the sun your enemy

BY FRANK HERBERT

Arrakis—Dune—Desert Planet. A wasteland where nothing lives except the spice and sandworms . . . Arrakis has special problems. . . . Storms build up across six or seven thousand kilometers of flatlands . . . blow up to seven hundred kilometers an hour . . . the pressures of thirst all around you. . . . Shelter means a hollow out of the wind and hidden from view. . . . The spice . . . is unique . . . it cannot be made . . . it must be mined on Arrakis.

PAINTINGS BY JOHN SCHOENHERR

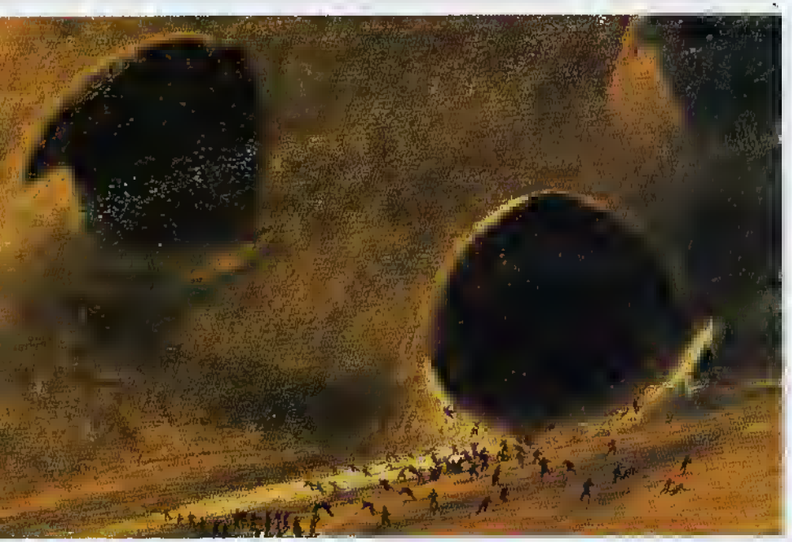
A basso voice rumbled, "The biggest mantrap in history. Is it not a great thing that I, the Baron, do?"

The Sardaukar . . . soldier fanatics . . . tough, strong, ferocious men . . . from the Emperor's prison planet. Sardaukar do not submit . . . they carry coils of shigawire in their hair . . . strong enough to garrote a man. *Top:* The Baron was grossly and immensely fat. . . . All the fat was sustained by portable suspensors harnessed to his flesh . . . his feet wouldn't carry more than fifty . . . of his two hundred kilos. *Above:* The name, Arrakeen, had a good sound, filled with tradition. The arched ceilings stood two stories . . . with great crossbeams shipped . . . across space at huge cost. . . . And this was a smaller city, easier . . . to defend.

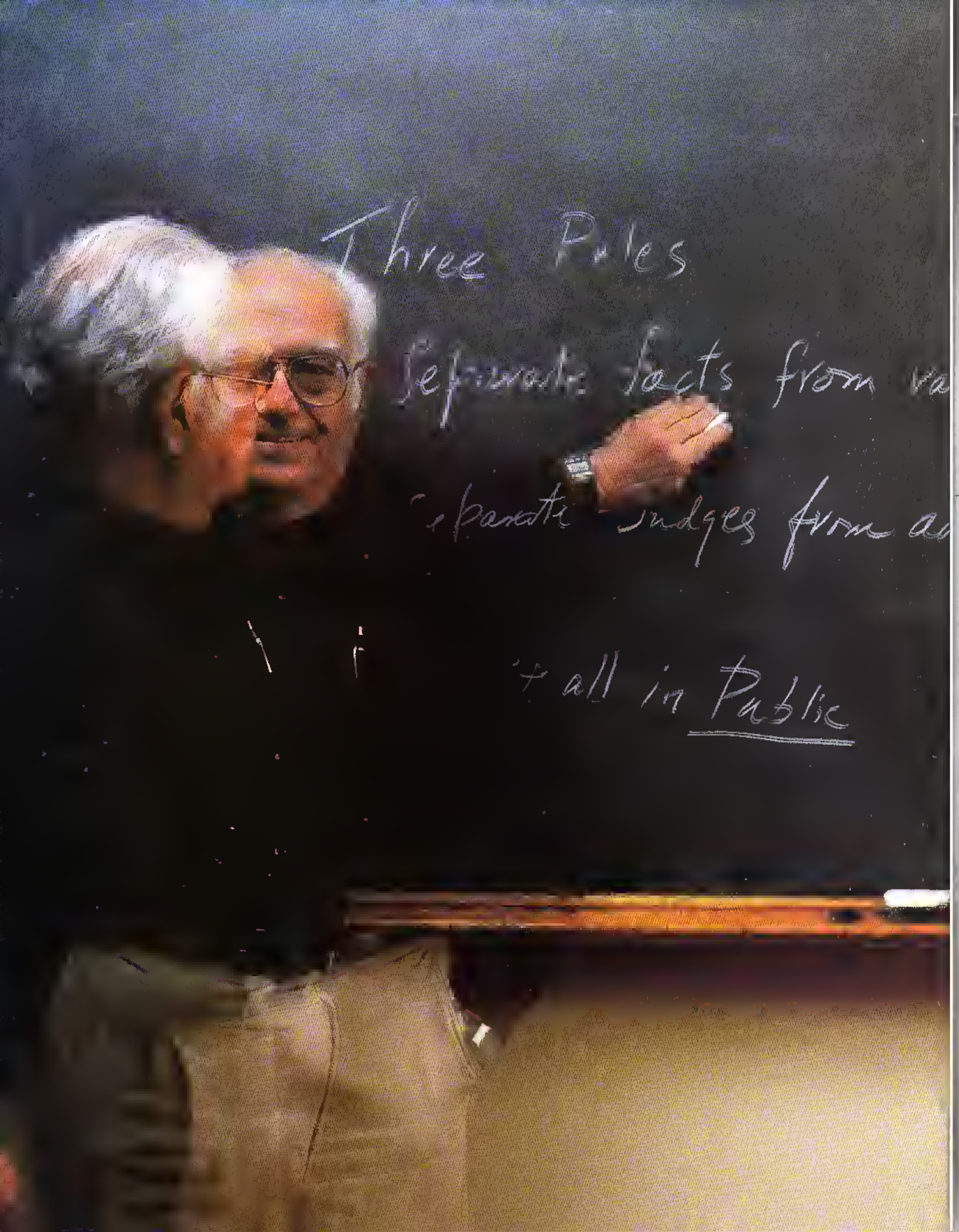
Across the sand, a giant worm—a maker—would hear and come to the thumper's drumming. When it came from the southeast . . . Paul realized he had never seen a maker this large . . . he waited on the sand outside its line of approach. . . . The wild maker . . . loomed almost on him . . . the wave lifted his feet . . . he steadied himself . . . lifted his hooks, sighted along them, leaned in. He felt them bite and pull. . . . Paul found himself riding upright atop the worm. He felt exultant, like an emperor surveying his world. . . . He spoke to Stilgar. "Then, I am a sandrider, Stil?" "You are a sandrider this day," replied Stilgar. *Right:* A roll of ball lightning bounced away from the wall. . . . "The shield . . . is down!" . . . 'thopters dived out of the night . . . in a hissing wedge. . . . And it was to the Arrakeen governor's mansion, the old Residency . . . that they escorted Paul Muad'Dib on the evening of his victory.

"All you must do is call the maker and ride him. Go, so you may travel the sand as a leader of men."

"Out of the haze came sandworms, a massed wall of them, each with troops of Fremen riding to the attack."



A silver-gray curve broached from the desert, sending rivers of sand and dust cascading all around. It lifted higher, resolved into a giant questing mouth . . . some eighty meters in diameter . . . crystal teeth with the curved shape of crysknives glinting around the rim . . . the bellows breath of cinnamon, subtle aldehydes . . . acids. *Above:* A tall man in a mottled burnoose stepped in front of Jessica. His mouth baffle was thrown aside for clear speech, revealing a heavy beard . . . but face and eyes . . . hidden in the overhang of his hood. "If you're fugitives from Harkonnens," he said, "you're welcome with us. I am Stilgar, the Fremen." ∞



A physicist who helped to master shock waves argues that society needs better ways to deal with future shock . . . while it still can

INTERVIEW

ARTHUR KANTROWITZ

Photographs by John White

Looking ahead has always come naturally to Arthur Kantrowitz. As a twenty-five-year-old technician, he wrestled with the problems of containing hot plasma in a toroidal magnetic field, the key to many fusion-power schemes. It doesn't sound futuristic in a world where several dozen experimental fusion devices have been developed from his humble beginnings, but Kantrowitz was doing it in 1938, when the basic physics of nuclear fusion in stars had just become clear. This early work with high-temperature gases has shaped much of Kantrowitz's career and has kept him at the cutting edge of science.

After studying physics at Columbia University, Kantrowitz went to Langley Field, Virginia, to study plasmas for the National Advisory Committee for Aeronautics, which would later become NASA. As World War II drew to a close, he moved to Cornell to teach the engineering physics of supersonic flight. His research group there developed new ways to create and study shock waves similar to the ones that batter an airplane breaking the sound barrier.

From 1955 until recently he directed the Avco Everett Research Laboratory, in Massachusetts, which produced reentry vehicles for ballistic missiles and the space program. Other projects included research on gas lasers and magnetohydrodynamic generators, which can extract electrical power directly and efficiently from a stream of hot gas. Working with his brother Adrian, a surgeon, he applied fluid mechanics to develop artificial heart valves.

In the mid-1960s Kantrowitz proposed a new institution, the Science Court, which he hoped would enable government officials to base their decisions on the best possible technical judgments, arrived at through a public-adversary proceeding. "Case managers" would argue opposing views on such issues as reactor safety and genetic engineering before impartial judges.

Today, as a professor at Dartmouth and MIT, Kantrowitz continues to insist that society needs new ways to come to grips with science and technology. *Omni* contributing editor Monte Davis asked him how one new idea, the Science Court, is faring.

"Scientists must confess their ignorance to peers because if they don't, they get stepped on. But outside the community many of them no longer feel bound by this rule of frankness."

Omni: In the years since you first proposed the Science Court, we've seen the molecular biologists' Asilomar meeting on recombinant DNA, the establishment of the Office of Technology Assessment [OTA], and Three Mile Island and the subsequent public inquiry. Do you think existing institutions or ad hoc groups are making the Science Court unnecessary?

Kantrowitz: I will be satisfied with the existing institutions when I see expert judgment regain a measure of credibility. As long as laymen, or scientists with sensationalist tendencies, such as Barry Commoner, have as much credibility as real experts, I say we lack something. When uninformed statements are taken more seriously than statements made by experts, we move into a dangerous future with a sea of misinformation around us.

Omni: What is the proper role of expert judgment?

Kantrowitz: It's a limited role, but a vital one: to make what Karl Popper calls falsifiable statements, the kind of statements that are at risk because they stand or fall with the evidence.

Among scientists there's one rule that you don't get away with violating: You must frankly confess your uncertainty and your ignorance. You must say, "I've done this much and no more; my results have this margin of error; and I'm still ignorant about this, that, and the other." You also give a prescription so that others can reproduce your results in detail.

Now scientists do all this because if they don't, they get stepped on by their peers, at conferences or in the professional journals. But when a scientist goes outside the community of his peers, he's no longer bound by this "frankness" rule. People don't hold him to it, and in fact with a little sensationalism he can get a reputation addressing national audiences that aren't equipped to evaluate his position critically.

I submit that scientific ethics should be extended to the public arena. In the Science Court, one would have to answer the questions of expert adversaries in public.

Omni: Where do existing institutions that tackle the issues of science and public policy go wrong?

Kantrowitz: Both the OTA and the National Academy of Sciences [NAS] have appointed expert committees to study these issues. But, it's very easy to appoint a "vectored" committee that will give you precisely the answer you want.

The NAS traditionally stressed that the public was to believe what it said, not because it understood how scientific judgments were reached, but because the NAS was an elite institution. And they've tried very hard to appoint balanced committees, because they take their noblesse oblige seriously. Their committee on nuclear and alternative energy systems struggled for years to resolve a deep cleavage in values that was apparent the day it was appointed, precisely because it was an honest attempt at balance.

As for the OTA, I was on a panel that included Daniel De Simone, who was then OTA's deputy director. It was billed as a debate on the Science Court proposal, but he completely endorsed it. He said that if a Science Court were attached to OTA, giving it a credible procedure for arriving at scientific facts, then OTA could really begin to deal with controversial issues.

The problem that no one has really faced up to is the myth of the "unprejudiced expert." As Warren Weaver once said, experts are men "intensively interested in X, often with lifelong dedication to X, and sometimes with a recognizably fanatic concentration of interest on X . . . quite clearly, just the lads to ask if you want to know whether X is a good idea."

Omni: Where then should we look for counterexperts?

Kantrowitz: For that, I think we have to be grateful to those I call the critical establishment—the Ralph Naders, Rachel Carsons, Barry Commoners, even Jane Fondas, who have achieved so visible a stature that many young people are inspired to emulate them.

You've got to find people who oppose, say, nuclear-power plants as strongly as the establishment experts advocate them, and people who have spent as many years studying the subject. One such person is Henry Kendall, an MIT physics professor who has been central to the scientific basis of the antinuclear movement through his work with the Union of Concerned Scientists. To have Kendall and Norman Rasmussen, for example, cross-examining each other in a Science Court proceeding before the public, each knowing the other will pursue every assertion long enough and hard enough to get to the bottom of the matter—that would bring to public debate the same care and candor that scientists use in communicating with each other.

Omni: Some people have said that adversary proceedings may work in law courts but that they don't belong in science.

Kantrowitz: They go on informally all the time within science, but for many scientists it would be just too bloody to do it in public. They say that "scientific objectivity" can't survive under that pressure; I say that what can't survive are the remnants of aristocracy that are so deep a part of the profession. "I'll give you the straight goods, because it's my duty as an intellectual aristocrat. I don't need to be cross-examined. I'm not going to say anything but the truth." Well, that can delude people only for so long. The pretense that a scientist's public assertions on a controversial issue can be taken at face value is as thin as the emperor's new clothes.

Omni: Name an issue that you'd take on as a case manager in a Science Court.

Kantrowitz: The construction of a magnetohydrodynamic-power plant. I assert that we should—not that I know it would work, but that it's promising enough to be worthwhile. The Department of Energy has taken the position that we shouldn't; they'll

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spend seventy million dollars or more a year on the idea, but they won't start building a pilot plant for at least five years, maybe ten. I would like to advance my arguments and have a chance to cross-examine the people who've been advising the DOE. I wouldn't have all the answers; frequently I'd have to say, "I don't know, but I'll consult with my sources and come back."

Omni: It sounds challenging, but could it offer the same satisfaction as being Barry Commoner, for example, analyzing the energy problem in terms of thermodynamic efficiency for the *New Yorker* audience?

Kantrowitz: And showing how thermodynamics leads to socialism? No. I'm advocating a more disciplined procedure. As long as Commoner's viewpoint is winning, he's not going to want to submit to cross-examination. The winners never do.

You remember the controversy in Cambridge over recombinant-DNA research at Harvard? I was at a New Year's Eve party there when the battle was on, and a molecular biologist—a leader of the pro-research group—came up to me and said, "You know, Arthur, we don't need a Science Court for this. We're winning."

That's why the procedure must be mandated, just as ordinary civil and criminal proceedings are mandated, although the strong don't need them.

Omni: Any other examples?

Kantrowitz: There was the debate over mass screening for breast cancer. Dr. John Bailar, of the National Cancer Institute, was convinced that mass X rays were doing more harm than good, but he got nowhere trying to persuade the National College of Radiology. So he threatened to convene a Science Court, and new guidelines for screening were issued.

In that case the guidelines came out of what are called consensus procedures, which are now well established at the National Institutes of Health. These procedures are public, both sides are represented, and there's no attempt to pretend there's no controversy, but generally there's no cross-examination, again because it doesn't fit the aristocratic tradition of the medical profession.

Omni: But then neither do malpractice suits.

Kantrowitz: And even lawyers are having to get used to those!

Another case involved a utility's proposal to build a high-voltage power line from somewhere in North Dakota to Minneapolis. It went through all the state EPA procedures and got all the necessary approvals—except from the farmers, who didn't want it. They started a protest movement, complete with rifles in their pickup trucks. The utility had gone through all the formalities, and so they sent out construction crews with rifles in *their* pickup trucks. Governor Rudolph Perpich [of Minnesota] sent out state troopers to keep them apart and contacted the American Arbitration Association. Because of the questions of health and safety involved with high-voltage lines, a Science Court was suggested, and with help from the Ford Foundation and the National Science Foundation we got the process started.

Unfortunately, the farmers' groups didn't want the questions limited to scientific matters, and the utility decided it would just as soon not have the health and safety questions thrashed out in public. It's almost a conditioned reflex for industrial public-relations people to say, "Let's not dignify the subject by discussion and aggravate the controversy; sooner or later the public will turn to something else and we'll go about our business." It pays for a corporation to deal with issues that way, but it doesn't pay for society.

Omni: Margaret Mead spoke in favor of your idea a few years ago, saying, "We need a new institution.... In many cases the institutions we have are not only unsatisfactory, they involve a prostitution of science and a prostitution of the decision-making process." How would you go about creating a Science Court whose personnel aren't indebted to existing interests?

Kantrowitz: As Mead saw, what we need is a cadre of people who are devoted to the new institution and who will try their damnedest to increase its credibility. They should be primarily concerned not with any issue before the Science Court but simply with finding the most competent and credible people to serve as case managers. I'm still struggling with the appointment mechanism, which has to provide a degree of immunity from the interests of the Establishment.

Omni: Have you been able to do anything as a teacher that might foster the growth of that cadre?

Kantrowitz: Last spring I taught an experimental course on technology and society at Dartmouth. It attracted mostly liberal arts and social science students, and I'm pleased to say that their ears were open. We got a dialogue started that I thought was effective, and they seemed to agree. We assigned each other required reading. Some advocated technology and some attacked it: critics like Ivan Illich and Theodore Roszak. All of us came out of it with a better understanding than the kind that comes from confrontation.

Maybe some of them, if they decide to campaign against nuclear-power plants, will do it by learning enough to really question the builders' assertions instead of by climbing over the fence. And maybe, if there's a Science Court, some of them will decide that's where they should be working.

Omni: Even the best procedures can't get around the fact that we have to make policy decisions in many cases before all the necessary evidence is in. And in some cases it's impossible to prove that there will be no ill effects from, say, microwave power transmission. What can we do about that?

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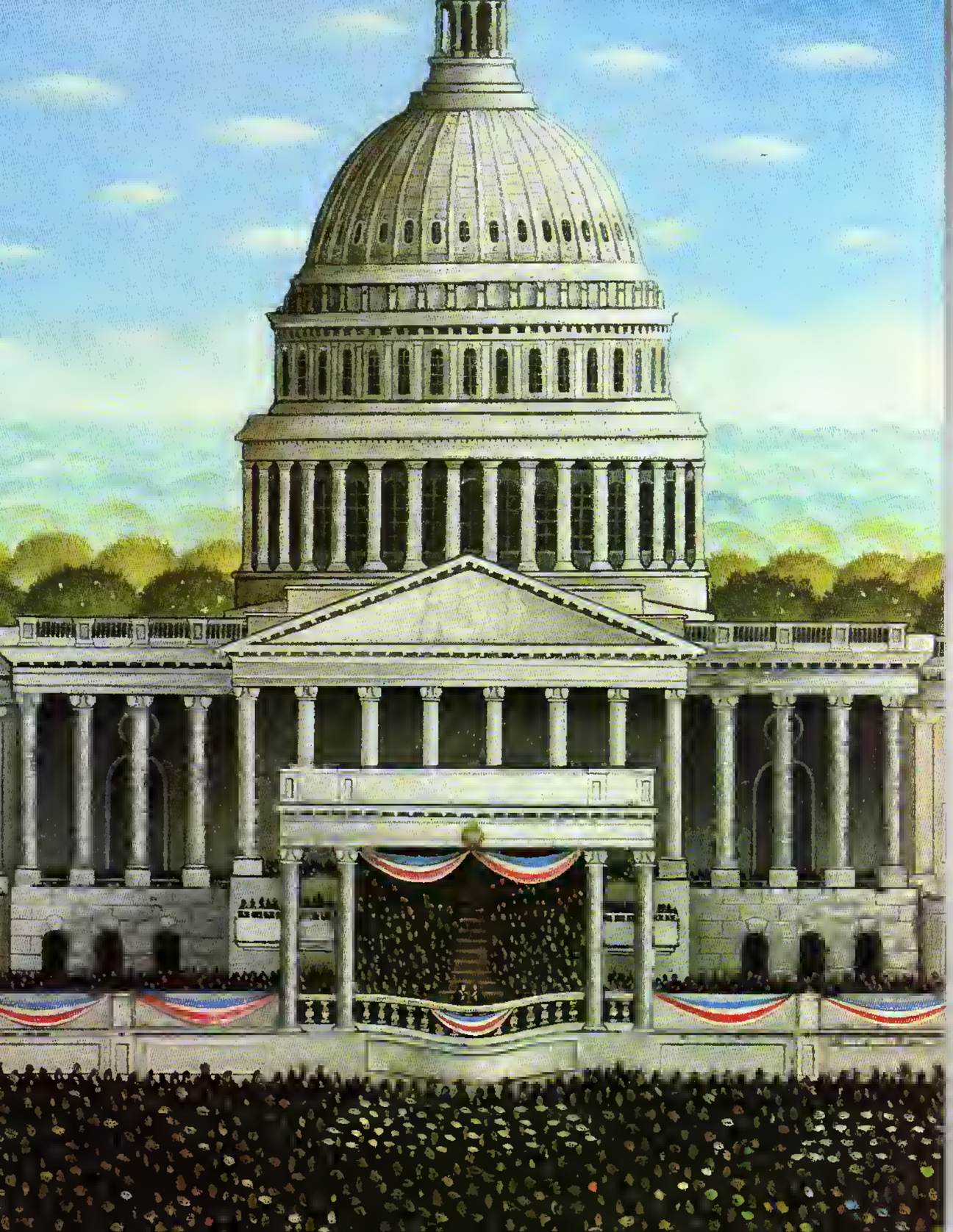

Burdened by overregulation, budget cuts, and red tape, American science needs a

PLATFORM FOR PROGRESS

BY DANIEL S. GREENBERG

Sift through the tons of rhetoric produced in this year's presidential campaign and you'll find hardly a topic that the candidates haven't buried under accusations, warnings, and unlikely promises. Inflation, taxes, and foreign affairs; defense, energy, and welfare; agricultural policy, Social Security, health care, urban affairs, and civil rights—the candidates have covered them, and the press has attacked them with aggressive questions and commentary.

Yet there is something missing. The federal government overwhelmingly dominates science and technology in this country. More than any other factor, federal policies, priorities, and administrative frameworks condition our quest for new knowledge and its applications. So why is it that not one of the candidates has made any significant statement about science policy?

If recent presidential campaigns are any guide, we may eventually hear a few kind words about the indispensable contributions of science and technology and the importance of keeping our scientific community strong. But when it comes to party platforms, it takes heroic scholarship—and some imagination—to distinguish Republican from Democrat on scientific matters.

For example, in the 1972 campaign, when Nixon-versus-McGovern offered a clear choice on many issues, the Washington correspondent of Britain's *Nature* accurately observed that "there are no large differences between the science policies of the parties. The rhetoric is the same—both platforms call for science to be used for the public good. . . ." The statements that candidates have uttered for professional scientific journals in several recent campaigns have been virtually interchangeable. This is

PAINTING BY RICHARD HESS

just as true of their speeches while they court voters who live near big research facilities.

California Governor Jerry Brown stands out as a bit of an exception—but no more than that—because during his brief and untruitful primary campaign he did speak fervently in favor of space activities and solar energy and against nuclear power. But regardless of what Brown chose to discuss, he was generally dismissed as a political eccentric. His abbreviated 1980 campaign does not upset the rule that elective politicking consistently ignores science and technology.

What's peculiar about this neglect is that few activities on the national scene are so tightly bound to Washington's money, power, and influence as science and technology are. They probably rank just behind the military services in their dependence on the federal purse. In other fields, this proximity stirs heartfelt passions.

Out of the $60 billion or so that's being spent this year on research and development in this country, about $35 billion comes directly from the U.S. Treasury, routed through a score of government agencies to university laboratories, industrial research organizations, the government's own big network of research facilities, and a few other places. Money put up by industry accounts for most of the remaining $25 billion.

Government money is even more important than those monumental figures suggest. Most industrial firms carefully choose research opportunities that offer a reasonably rapid payoff—five years is a rule of thumb for many companies. Therefore, industrial research concentrates on near-term, profit-making sure shots.

A lot of important research takes far longer than five years, however, and even then does not necessarily yield marketable results. In our heavily taxed economy individual philanthropy and foundations count for less and less. State governments put little money into research. So the federal government concentrates its R&D money on longer-term, more speculative research.

The National Science Foundation reports that the federal government finances about 70 percent of all basic research in the United States. It's the only source of funds for the nation's high-energy particle accelerators and interplanetary research. Federal money has financed the work of most of our Nobel laureates. Without it, many of the most dynamic fields of contemporary research, among them molecular biology, solid-state physics, and nuclear fusion, would be far less developed. Simply put: Washington pays the biggest part of the bill for American science.

The prime mover in getting money for science is the President of the United States. It's the President who tells Congress what the country should be doing about science and technology. Though Congress often puts its own imprint on his designs, what comes out of the legislative process generally bears a strong resemblance to what the President fed into it.

Since Congress tends to deal with R&D matters through funding agencies and leaves the day-to-day details to the agency chiefs, the President's choices for those key jobs, and the policy directives he gives them, are at the heart of American science and technology. He appoints the chiefs of NASA, the National Science Foundation, the Department of Energy, the Environmental Protection Administration, and the Department of Defense—which by itself performs and contracts for as much research as all the rest of the government combined. In the long run the research decisions made by these organizations have immense political consequences. Any doubters should consider the influence of nuclear weapons and intercontinental missiles on international relations or the strength we derive from our science-based agricultural productivity.

The President's handpicked White House science adviser occupies the single most influential position in the government science hierarchy, working closely with the President's chief manager of government spending, the director of the Office of Management and Budget. The science adviser also serves as the administration's chief spokesman for R&D before Congress, the research professions, and the public. He represents the United States at the policymaking levels of international scientific collaboration—a booming field involving dozens of major R&D compacts between this nation and other nations.

Presidents set the pace for government-supported science even more directly, both in pork-barrel politics and in enlisting science and technology to solve the nation's many problems.

Consider the following: Fiscally conservative Dwight Eisenhower rejected a big, expensive, and ambitious space program. John F. Kennedy, eager to project an image of national vigor and technological supremacy, reversed Eisenhower's policy and began the Apollo moon-landing program—the greatest technological enterprise in man's history.

Lyndon Johnson, a graduate of Southwest Texas State College, brought to the White House his mistrust of elite eastern and California universities and decreed a "spread the wealth" program. One result: The then-biggest particle-accelerator facility in the world, the $240 million Fermi National Accelerator Laboratory, was constructed in Batavia, Illinois—not where its California designers expected.

Richard Nixon, suspicious of the Eastern Establishment and its many influential science advisers in government, sharply reduced federal spending for scientific training, thereby precipitating a decline in the number of graduates in many disciplines. Nixon launched an ill-conceived "war on cancer" as a political ploy, draining

CONTINUED ON PAGE 114

WINNERS

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unprecedented three U.S. national championships. Before the 1978 Nationals, Deem and other participants went through a sophisticated battery of evaluations and tests. The testers told Deem that his oxygen-intake levels, a vital measurement for a biker, simply didn't measure up to world class standards. Although his body hadn't changed a whit, Deem never won a major competition after that scientific pronouncement. The precise technological evaluation made it psychically impossible for him to compete at the top of his sport.

Still, those in the profession believe, the benefits of the new ideas and technologies far outweigh their drawbacks. As coaches become more familiar with biomechanical evaluation, the gap between scientific needs and athletic habits will narrow. Roger Counsil, coach of Olympic gymnast Kurt Thomas, notes, "Coaches have grown in their ability to analyze the mechanics of sport. This allows us to teach greater difficulty with greater safety. We have coaches more competent today than there have ever been. The training methods for coaches have changed; now they emphasize biomechanics and computer analysis. As coaches become more familiar with sports science, they'll be better able to get athletes to understand and use it."

O'Shea, however, feels scientist-coaches can have only limited influence on sports unless there's a societywide system that encourages athletic development. "I think the Olympic Committee needs to get down to earth, profiling youngsters at an early age, as the East Germans do, instead of working with computers and athletes after the athletes have already achieved a successful style of performance. I'd like to see Bruce Jenner cartoons for kids."

In San Francisco psychologist Joan Barnes is taking a first small step in this direction. Her Kindergym is loosely modeled on the East German system of scientifically stimulating athletic achievement from earliest childhood on. A "noncompetitive, free-form play environment," Kindergym takes children from three months to four years, accompanied by a parent, and "guides them through development of body and spatial awareness, eye-hand coordination, locomotor skills, and gross and fine muscle development." Children run, jump, climb, and crawl around at their own pace to lively music. They work out with brightly colored, toddler-size equipment made of aluminum, molded plastic, and wood. They can choose from various gym gear, such as tunnels, tumbling mats, stacks of inner tubes, walk-up slides, trampolines, ramps, balance beams, bars, bells, scooters, and silk parachutes.

The problem with this kind of early development system is that the young athletes must retire their numbers so soon. There aren't adequate follow-up programs. After graduating at age four, youngsters often do not confront scientific training and coaching again until high school.

Earlier athletic conditioning and selection would create a generation of injury-resistant athletes, a greater contribution to sports than anything else science has provided so far. Dr. John Marshall, who was the chief sports doctor for New York City's schools and numerous professional teams until he died in a plane crash this spring, said, "Despite all the advances, we sports physicians and surgeons just haven't created anything new in terms of concepts. What we do are merely things that have been done for at least a couple hundred years. We refine them. We polish them. We improve the technical aspect. But the same injuries occurred twenty-five years ago that we see today. Not all physicians appreciate that. We can't really say we've made progress until we weed out these recurring injuries. We need to prepare the young for injury-free performance."

Already the concept of careful cultivation and selection of athletes has made serious strides in professional ranks. Today's pro is a far different creature from his predecessors because he has been crafted differently by his environment.

"He's taller, quicker, stronger," says John Mazur, defensive coordinator for the New York Jets. "He's had better programs when young, better foods, more opportunities for weightlifting. Even a few years ago weights were taboo—Nautilus, the whole bit."

Bill Hampton, the Jets' equipment manager, says, "Fifteen years ago a twenty-eight-inch waist was unheard of. They were all thirty-four to forty-two inches. Today kids are perfect specimens—six feet three, two hundred forty-five pounds, thirty-four-inch waist. I don't know whether it's nature or just that the new generation wants to be able to fit into their Jordache jeans or what."

This change in athletes isn't so much the result of improvement in the human species as it is in techniques of selection and preparation. "Evolution will change things, but that takes hundreds of thousands of years to occur," Dr. Marshall said. "For one tiny change in a bone or for one little ligament to migrate from one place to another—these go way beyond practical planning strategies. So the changes we see now aren't genetic."

Marshall cited football as an example. A few decades ago teams had 32 players, who played on both offense and defense. Today each position is highly specialized, and each athlete is tailor-made for his task. Marshall explained how improved methods of selection helped to bring these changes about.

"Now you have a one-hundred-seventy-five-pound defensive back who has great hands and plays a lot of sports very well. Then you have a two-hundred-seventy-five-pound offensive lineman who doesn't have the quickness, but he has bulk and a lot of momentum. You have widely divergent athletes on the same team. We select

players now for specific criteria. We look for weight, size, forty-yard speed, vertical jump, muscle-fiber type, upper-body strength, lower-body strength, and more. If a player has just a few things to do exceptionally well, his performance ought to be better."

Despite this specialization, an athlete still can overcome body limitations and succeed in a sport through sheer determination and talent. Danny Padilla, for example, is a world class body builder at the improbable dimensions of five feet two and weighing 180 pounds. In New York last year Padilla used style and what he calls "the most symmetrical body in the world" to beat out the brawny behemoths.

The point is that optimum curves of performance and body type are based on specific ideas about what and how an athlete should perform. A new idea relating to performance can create a wholly different concept of the "perfect athlete" for a particular event. A good example is the invention of the Fosbury Flop for high jumpers, which shifted the emphasis from tight, muscular leapers to loose, angular types with lean, aerodynamic lines. Even with all the advantages of computer selection, athletics remains a subjective, dynamic science.

Apart from training and selection, science has helped athletes by improving their playing equipment. The space program, which has been a sports innovator ever since the development of the hang glider in the 1950s, has played a significant role in improving athletic equipment.

A report by astronaut James A. Lovell, Jr., in *Aviation, Space and Environmental Medicine* magazine, for example, lists lightweight sportsman's blankets and jackets, sleeping bags, and ski parkas made from "the aluminized plastic originally devised to keep cryogenic fluids cold in space" as among the benefits accruing to sports from space exploration. The report also mentions rechargeable heated gloves and ski boots, light composite materials for golf clubs and fishing rods, and antifog compounds that keep diving masks as clear as they once kept spacecraft windshields.

A new silicon plastic foam from NASA that takes the shape of impressed objects but returns to its original contour after even 90 percent compression is being used for football headgear. Looking forward, enormous possibilities loom for NASA's recently patented portable breathing system. Designed for zero-g use, it reconditions air using lithium oxide in a sealed system.

The success of these NASA developments has caused some never-before-dreamed-of problems. In football, for example, the foam-lined helmets have proved so effective at protecting the wearer that players have begun using their heads as battering rams against opponents. With older helmets, the impact of a head-on crash would bother both players involved, but the new helmets allow huge linemen to slam their heads recklessly into the ribs and spines of halfbacks and wide receivers. Hampton likens the situation to a Volkswagen getting juiced by a Cadillac.

Fortunately, no such problems have arisen with NASA foam-lined shoes. Tennis star Jimmy Connors and the New York Knicks have found that the plastic, which molds to the exact shape of the wearer's foot and which doesn't slide against the skin, has reduced footaches and injuries and has made them better performers.

Beyond all the prosaic advances in training, attitude, selection, and equipment lies a realm of possibilities about the zenith of sports science: creation of a perfect athlete through genetic manipulation and drugs. The current controversy over improving athletic performance through anabolic steroids is only a small-time indication of the kinds of manipulations that may lie ahead.

Steroids are hormonal compounds believed to increase training's effects and an athlete's aggression if taken in huge, sustained doses. After the East German female athletes trounced all comers in the 1968 Olympics, amid rampant rumors that they had stuffed themselves with steroids, the practice caught on with athletes everywhere. The reason is fundamental: The athletes believe the compounds will better their performances.

"By taking anabolic steroids," writes Dr. H. Howald, "one hopes for improved protein synthesis in the body and consequently muscle growth, such as would not be possible through physical training alone, no matter how intense."

The expanding popularity of steroids raises some concern that the Summer Olympics in Moscow, with or without the Americans, may prove to be a competition among drug companies. The glamour attached to winning and the lure of big money from commercial endorsements are attracting athletes even down to the high-school level toward steroids.

Dr. Gabe Mirkin, in his *Sportsmedicine Book*, admits, "So pervasive has the practice become that professional, college, and even high-school football coaches routinely dispense steroids."

Jan Sletter, who trains Olympics-bound gymnasts, claims that some members of the wrestling and swimming teams at Rutgers University, in New Jersey, used steroids a few years ago when he was there. Ariel, who was at the 1976 Summer Olympics in Montreal, says, "If you were in the weight events, you wouldn't even make the trials if you weren't taking steroids. In the shot put the difference between those on steroids and those not was as if one group was putting sixteen-pound shots and the other was putting forty-pound shots."

Both Ariel and Dardik are convinced the use of steroids is widespread in the United States. Then, it may be asked, why hasn't the phenomenon been investigated by

medical authorities? Why aren't there studies about the best uses of this potentially dangerous drug?

"There are a couple of reasons why," Daidik says. "The main one is an international law about experimenting with humans. It is necessary for someone to give consent now, but the critical point is that even with consent, the work must be justified. Can it be justified to see whether you can improve an athlete's performance by using drugs? The only real justification for using drugs is for medical purposes, and here you're giving an athlete anabolic steroids, potentially harming him, just so he can win medals or break records. How can you justify that? There were studies in the past, but they've stopped."

The outcry against the drugs—which carry the potential for later heart and liver ailments, among a host of other ills—has led some to consider the possibility of obtaining similar results through genetics. Drugs, after all, are merely an artificial means to shift hormone levels set by the genes in the first place. If you could manipulate the genes, you could create a pumped-up athlete without the bad side effects of drug use, and without raising ethical questions.

This has deepened into a question of when science will be able to produce enough genetic control to engineer the genetically perfect athlete, each trait selected to provide ultimate performance.

Such possibilities lie far in the future, according to Dr. Norton Zinder, a geneticist at Rockefeller University, in New York City. Dr. Zinder notes, though, that "while these things are impossible to do physically today, they can be thought about. This is actually what frightens those people who like to get frightened, that we can even think about such things. You can't say we won't be able to do it someday. In fact, most people say sooner or later we will. But you can't put a time on it."

Now geneticists can identify a few specific genes and have the basic technology for transferring a specific gene from one cell to another. But that doesn't help much with sports, Zinder explains. "You don't expect there's a single gene that says make me an eye or make me a knee. And even if there were, within our genetic material there are millions of genes. How in blazes do we find out which one in that million is the one for the eye?"

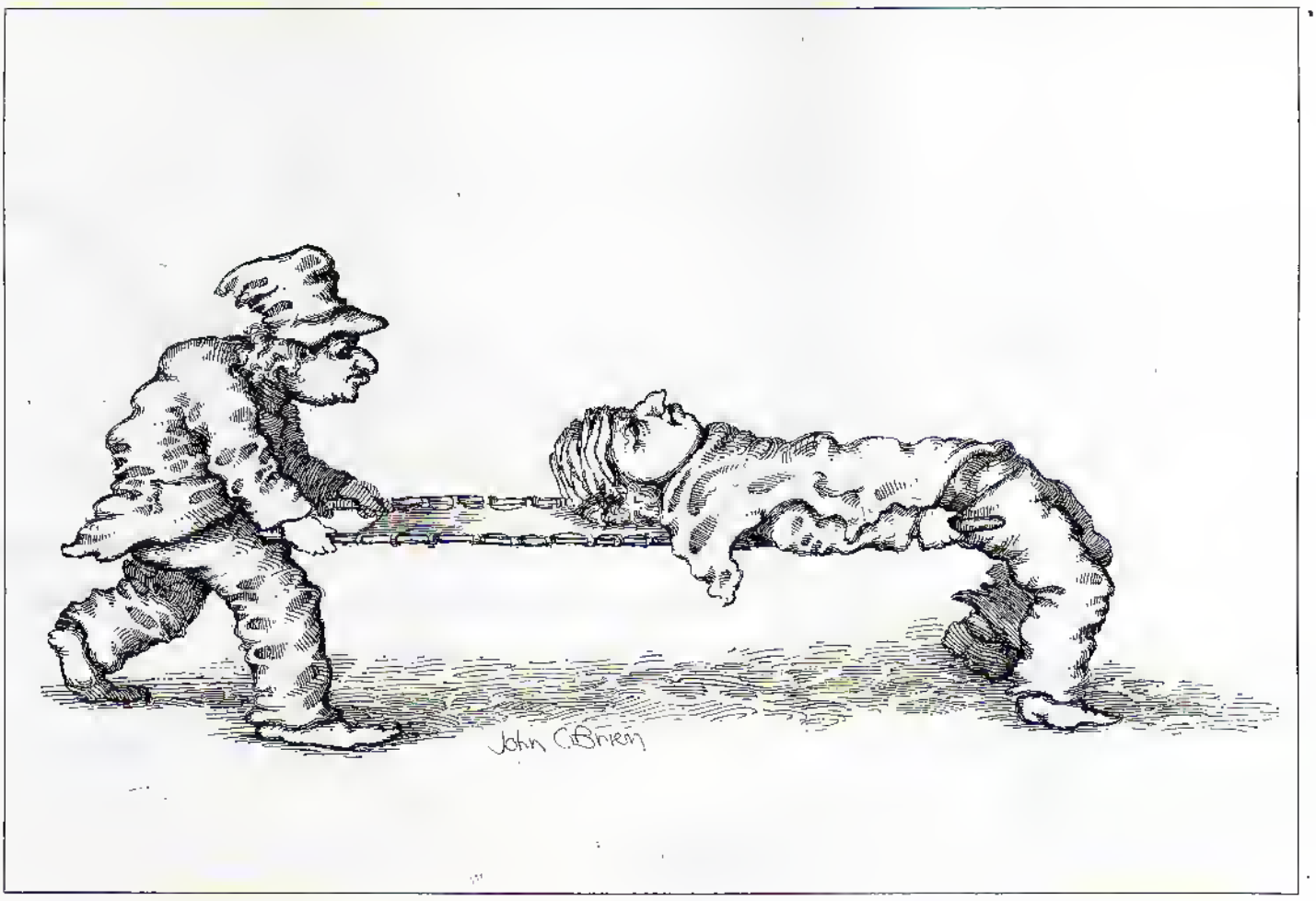
Half-seriously Zinder advocates an approach to genetic athletic creation that will bring results far sooner: "Selective breeding. If it works for sheep, goats, and cows, it'll work for humans, and in a few generations we'll have a lot more athletes. Unfortunately, this requires a tyrant if it is to succeed. The farmer is tyrant to his bulls and cows. Freedom versus efficiency. It may be paradoxical, but it's the choice we have."

A new choice for maintaining high athletic levels may be cloning. Even football players, such as guard Doug Van Horn of the New York Giants, look forward to the day "when I can send my clone in to do it for me."

"That, of course, is science fiction," says Dr. John Rainer, chief of psychiatric research, medical genetics, at New York State Psychiatric Institute, in New York City. "But will it ever be possible to actually take an athlete, take his cell, take a fertilized ovum, take out the nucleus, and replace it with the nucleus from the athlete's cell to grow into an exact duplicate of the athlete? It's not around the corner, not twenty-five or fifty years, but maybe in a hundred years. After all, if you can send a man to the moon, I suppose you can clone a human being."

While we wait for cloned and gene-spliced champions to appear, we can warm ourselves with the knowledge that present methods, and those just ahead, will continue to produce ever-improving levels of athletic achievement. For the moment our athletes' genes will remain unchanged, but science's impact on all aspects of sports will bring their performances ever closer to the ultimate those genes allow their bodies to attain.

"I've learned there is no such thing any longer as a physical limit," Counsil says. "It's the nature of the human animal to improve constantly. What I thought were limits have now been passed. If there is an end to what we can do, it's not within my comprehension." ∞



PSYCHOGRAPHICS

CONTINUED FROM PAGE 56

a network gave me film clips of twenty-five potential guest stars for a prime-time show—people like Peter Frampton, Cher, Johnny Cash. I played this stuff for one hundred people, and it turned out that for the men Cher was number one and for the women Cher was number three. Very, very high. I reported this and they said, 'No, we don't buy it. We ran focus groups, and the women think she's a tramp; she wears see-through blouses; she's in and out of bed with men. They won't tune her in.'

"I said, 'Oh, no?' They said, 'We have verbatims!' I said, 'I don't care if you have blood types. What these women are telling you is that *they* are nice ladies, that they don't wear transparent brassieres or whatever. That doesn't mean they're not going to watch.' But the network ignored the study, and a couple of months later a rival network put on a special called *Cher and Fantasy*, and it did fantastically well."

Not everyone is impressed by Weinstein's success. Ina Hillebrandt, director of Hillebrandt Consultants, Inc., says, "The advertising community's reaction was very negative. I personally found Weinstein's research interesting, particularly as it applies to the medium you select. If the left brain responds better to radio than to TV and the right brain responds to radio, too, there are enormous implications for lowering the cost of an advertising campaign."

Why do people respond so negatively? "It's very competitive," says Hillebrandt. "I think a lot of people are extremely jealous that someone could come up with hard data like that and have it make sense."

Since brain wave research was first applied to advertising, its major corporate supporter has been Dr. Herbert Krugman, manager of corporate public-opinion research at General Electric since 1969. Today Dr. Krugman is one of the few people publicly theorizing on the subject. What he finds interesting in current research is its ability to identify which medium "creates thinking and which creates imagery without thought."

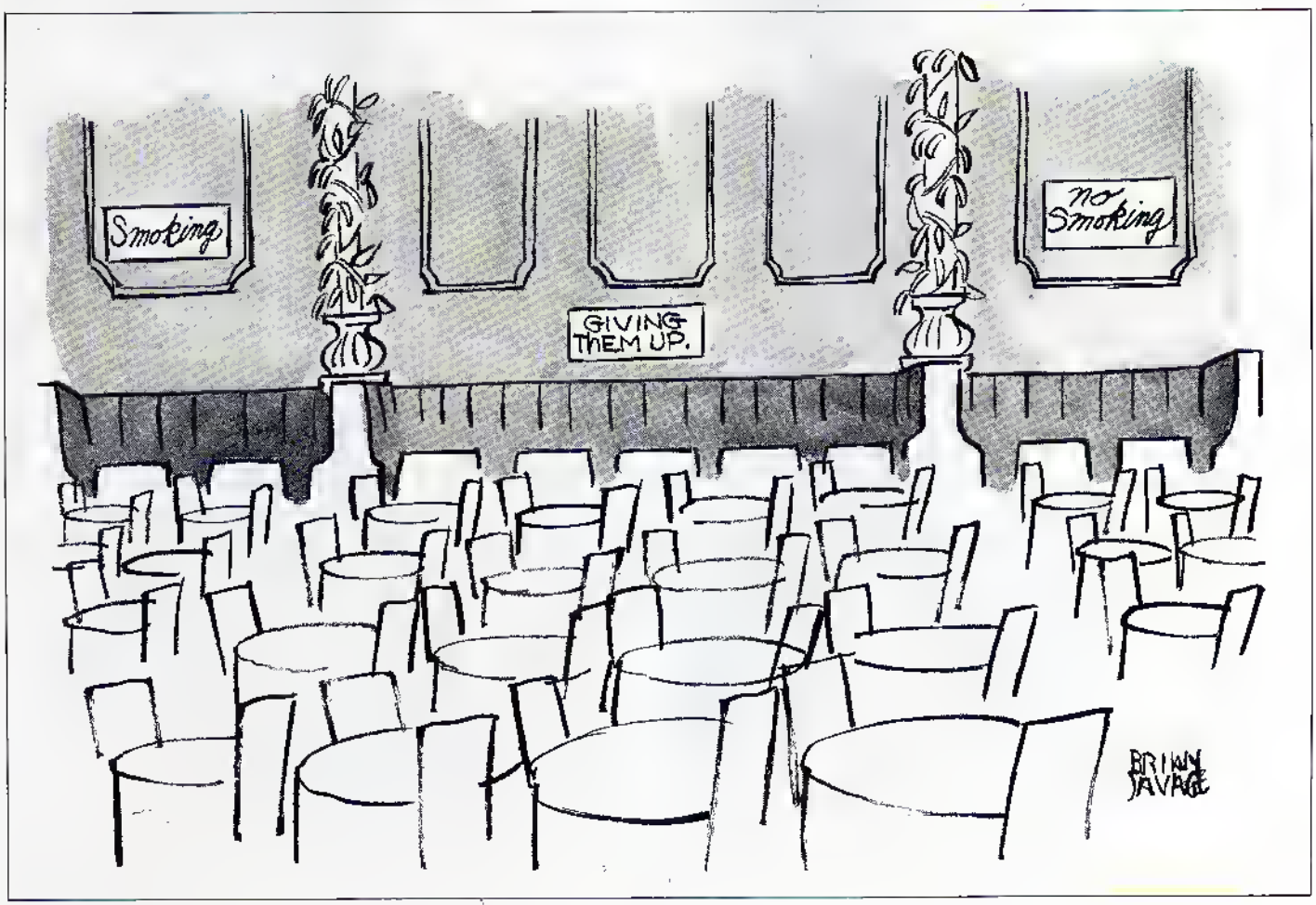
Weinstein's NeuroCommunications Laboratory recently tested a series of G.E.'s corporate commercials for Krugman. A corporate commercial doesn't attempt to sell a product; its purpose is to develop an image and generate good feelings about the company. This series featured Thomas A. Edison, portrayed by a well-known actor in a variety of brief entertainments. Weinstein and his staff analyzed the degree of left- or right-hemisphere activity that each five-second segment of the commercial evokes.

Their findings emphasized the separation of images and ideas, which supports the hypothesis that much of our response to both advertising and television occurs in the right hemisphere, even when there is a lot of verbal content. For example, in some of the G.E. commercials Edison tells stories that produce a right-brain response only. Krugman attributes this to the vivid pictures evoked by the text: "The switch was thrown in Niagara. The lights came on in Buffalo." Stories that more equally engaged both sides of the brain dealt with ideas.

In one commercial the mention of Edison's deafness produced a sudden switch from right brain to left. Krugman interprets the cause as a startle mechanism, suggesting that the element of surprise sets off speculation or a chain of ideas rather than image-related associations.

It was especially provocative that the final images of all the commercials produced a right-brain response even though some contained words while others included print superimposed over video. Krugman speculates that the left brain was not activated because the words were not being read but viewed as part of the picture. In any case, Krugman concludes that the words are not being processed as ideas and that their thought content is nil.

Many possible uses exist for such information. If an advertiser is trying to sell on the basis of mood, life-style, or emotional or subconscious response, arousing the left brain and setting off a cognitive process would be a mistake. Should the campaign be designed to appeal to logic, such right-brain material as strong music or



mood-evoking imagery might interfere.

"The ability of viewers to show high right-brain response to TV and print advertising," Krugman wrote in a 1979 *Broadcasting* editorial, "suggests that, in contrast to teaching, the unique power of the media is to shape the content of people's imagery, and in that particular way determine their behavior and their views."

If you want to shape the content of people's imagery, however, you must first have access to the raw materials—their fundamental beliefs today and, more important still, what they'll be thinking tomorrow. The best documentation of how attitudes have changed among different segments of the population comes from psychographic studies, especially those spanning a decade or more. All marketers agree that the biggest rewards go to those who can cut through the mountains of data and spot a trend picking up momentum. Indeed, a capacity for "visionary thought" or "crystal balling" is considered a qualification for entering the field.

"It's very difficult to tell the difference between a trend and a fad," says Barbara Caplan, of pollsters Yankelovich, Skelly and White. "Sometimes we call it, sometimes we don't." Dr. Caplan, who tracks more than 40 trends in the Monitor analysis, estimates that "we have a lot of historical material on where people have been moving, what their priorities are, how they feel about themselves, raising kids, spending money, saving money, how they feel about work and leisure, how they view the future compared with the present and the past. . . . And we analyze the data in terms of what it means for our clients—General Motors, for instance."

Our commitment to the "natural," still a trend, but one on the wane, was "called" by Monitor, Caplan says, long before it became obvious in the press. "And after ignoring physical appearance for a long time, signs began appearing in the data pointing to a renewed interest in personal looks. Then it was confirmed in the marketplace—apparel sales shot up along with jewelry and signature clothing. When you do this long enough," she explains, "you develop antennae, and you can say, 'Hey, this one really tits.'"

Social psychologist William D. Wells, now a vice-president at Needham, Harper and Steers, believes that successful marketing is 95 percent intuition and 5 percent hard data. Nonetheless, Dr. Wells cautions against relying on antennae too much: "Fifty percent of the trends that are said to be occurring are not occurring at all. Many things that appear to be trends affect a very small part of the population. For instance, interest in Zen doubled in two years—from two percent to four percent. So what?"

If any of this research is going to change our world—and probably all of it will—the most subtle and profound changes could come from the perceptual engineering going on at firms like the Weston Group. The psychophysics principles used to formulate the ideal granola are already being refined by Dr. Moskowitz and others for future use in packaging political candidates. But even if psychophysics and politics never merge in the real world, the recipes Moskowitz is punching up on his console today will certainly affect the taste and content of the food we'll eat tomorrow, as well as the images through which we are encouraged to buy it.

Moskowitz has already proved that brand awareness and packaging affect our perceptions of a product's reality. Sensory characteristics are modified differently for different products. A chocolate bar may seem sweeter to the panelist who doesn't know the brand than to one who peeled off the wrapper. Or a panelist may perceive a sauce as "more Italian" when she's seen the label than when it comes from an unmarked can.

One of the eeriest things Moskowitz does is to make mathematically tangible such intangible qualities as "Italianness," "old-fashioned flavor," and "natural taste." It doesn't disturb Moskowitz that some products tested for naturalness got higher ratings in an artificial version than with a recipe using only natural ingredients.

"What we're doing is finding out what the consumer considers natural and converting that into ingredients," he says. "We are transforming product wishes into product formulations. If the consumer wants 'a natural taste,' and if the consumer feels lemonade with additives tastes natural, that's what we'll give her. Lemon flavor is lemon flavor, whether you get it from a tree or from an artist flavorist. The constituents are different, but what is perceived as lemon flavor *is* lemon flavor. That's reality.

"Nobody's saying you have to use this indiscriminately. If the consumer wants a potato chip with something unhealthy in it, you don't have to put it in. But we're more than just quantifying the American Dream. We're telling people how to manufacture it better, faster, and cheaper."

But why do we need a better potato chip anyway? Aren't the ones we've got good enough?

Out of approximately 54,000 active grocery items, the average supermarket can stock only 8,000 at any given time. Yet the number of brands, items, and sizes steadily increases. It's not because there is a real demand for a better potato chip, but because dissatisfaction and constant, if vague, yearnings for the new and improved have been programmed into us.

Unfortunately, most of us adopt the unarticulated fictions with which the messages of advertising saturate us daily. Our striving to make real those unattainable desires becomes focused on *things*, even when we perceive them as impulses toward experience. As Stannard put it, people are buying a dream with the $200 tennis racket. And it isn't going to improve their playing one bit.

SIGMUND

CONTINUED FROM PAGE 70

has it really worked. *Three centuries in a cube*, Freud thinks bitterly. *Three centuries*: They should have allowed his corpse to commingle with the earth undisturbed; they should have left him with the less noted of his time; they should have spared him this difficult and humiliating afterlife. What they need aboard the *Whipperly VI* is not a doctor but a priest. Freud can offer them no solutions; he can, at best, take them further into their unspeaking, resistant hearts, at the core of which outrage has been transformed into insanity. It is not the Vegan cancer probes that the captain fears; it is himself. If he were to be shown that, he would die.

This line of thinking, however, gives Freud an idea. He returns once more to his cubicle and uses the communicator to summon all officers and crew to an emergency meeting in the lounge in ten minutes. Then he uses the special device he has been shown and speaks to the administrators. "I want to tell you," he says, "that your twenty-fifth century is finished. Your deep-space probes are finished, and your Vegan mission is done."

"Why is that?" one administrator says flatly. "Aren't you being a little florid?"

"I am telling you the truth."

"Why is that the truth? On what basis are you saying this outrageous thing?"

"Because you have pushed limits, you have violated circumstances, you have misunderstood the human spirit itself, you have lied your way through the circumference of the planet, but you cannot do it among the stars," Freud says, and so on and so forth and on and on. He permits himself a raving monologue of two minutes in which he accuses the administrators of all the technological barbarities he can call to mind and then says that he has found a one-time, stopgap solution to the problem that can never be used again but that he will invoke for the sake of all those on board who cannot discern their right hand from their left and also much cattle.

"What is that?" the same administrator says weakly. "We have no cattle on board. I don't understand. Explain yourself before you're dwindled on the spot."

"You won't dwindle me," Freud says. "You don't dare do it; I'm your last hope. If you shut me down, you know the mission is finished, and you can't deal with that. So you're going to let me go ahead. And afterwards I don't care what you do. You are monstrous yet unconvinced of your monstrosity. That is the centrality of your evil."

It is a good statement, a clean, high ventilation. Feeling as triumphant as the captain preparing his crew for dangerous probes, Freud shuts down the communicator, leaves his cubicle, and descends to the brightly decorated lounge, where forty members of the *Whipperly VI* crew sit uneasily, staring at him, waiting for him to speak. Freud stands on the Plexiglas stage, swaying unevenly in the wafting, odorous breezes of the ventilators.

"All of you should know who I am. I am Sigmund Freud, a famous Viennese medical doctor and student of the human mind who has been reconstructed to help you with your difficulties on this Vegan probe. I have come to give you the solution to your problems."

They stare at him. The hydroponics engineer puts down her gun, folds her hands in her lap, and looks at him luminously. The captain giggles, then subsides. "Ah, then," Freud says, "you must repel the Vegans. Caution will not do it. Circumspection will not do it. The lies of the administrators will not do it. Only your own courage and integrity will accomplish this."

Chairs shift. The captain applauds fervently. "Understand me," Freud says, nodding at him, "the administrators have lied to you. They have always lied to you. Spaceflight is not the routine transference of human cargo. Space itself is not the ocean, and a star probe is not a nineteenth-century battleship. Vega is not the Azores! Conditions are new and terrible. Monsters lurk through the curtains of space. Everything is changed."

"Yes," the captain says gratefully, "everything is changed. I tried to tell them—"

"It's too late to tell them," Freud says sharply. "You must act. You will land on Vega and advance upon the Vegans' cities and kill every single one of them. Until then you will remain quiet and you will plan. I will see each of you individually to tell you what role you will play in the conquest. For the moment, thank you and bless you all."

He bows. The applause begins. It swerves toward him in thick, deepening waves. Freud is humbled. Tears come. It has not been this way for a long time, since the Academy as a matter of fact, and then there were the jeers and abuse of some rivalrous colleagues. He basks in the applause. Even a reconstruct can be permitted vanity. Finally, he bows and stumbles from the stage, then moves up the ramp into the darkened corridors above.

Pacing, he adjusts the viewscreens so that he can stare again at the dark constellations—which he no longer fears. Freud thinks that in this maddened circumstance, almost six full centuries from Vienna, he has found some qualified answer to his problems. It is possible to say that his final moments are happy or at least as happy as a scientist of the mind may make them. But they come, as do the emotions of all the others, to a startling termination.

The mission is aborted.

Not by the administrators. For Freud, these men of steel and power now have only the greatest respect.

But by the Vegan space probes, which do not bring cancer (the captain, like many insane, was intellectually damaged), but the fire. ∞

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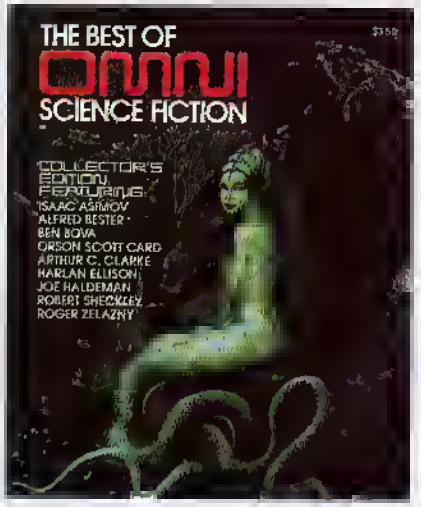

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Burt Rutan designs do-it-yourself dreams come true

RARE BIRD

TEXT & PHOTOGRAPHS BY ANTHONY WOLFF

It doesn't take an expert to see that Burt Rutan designs the most beautiful light planes in the sky, sleek and elegant incarnations of the fantasies that fly in kids' daydreams and science fiction. By comparison, even the very latest models from the big names—Piper, Cessna, Beech, and the rest—look like warmed-over Piper Cubs, so alike that only an ace can tell one model from another. If they were merely beautiful, Rutan's planes would be aeronautical trivia; they wouldn't matter. According to the numbers, however, Rutan's planes not only look better than the rest of the light-plane flock; they fly better, too. They climb and cruise faster, carry heavier payloads farther on a gallon of gas, and cost less to buy and to maintain. And for all their radical beauty, hotshot performance, and economy, they are inherently safer than conventional designs. In the fast-expanding world of light-plane aviation, Rutan is famous for almost single-handedly pushing the state of the art into the future. He is a peerless peer

Top: Rutan toys with his five- seater twin Defiant. Right: The 100 hp VariEze, Rutan's paradigm, cruises on four wings at 195 mph.

Like a latter-day Wright brother, Rutan invents airplanes obsessively and almost alone.

in the Experimental Aircraft Association, whose members design, build, and fly their own planes. At the EAA's annual midsummer fly-in at Oshkosh, Wisconsin, three of Rutan's planes—beginning with the VariViggen, followed by the VariEze and then the Quickie—won the Best Design award in their debut years. In 1979 a VariEze was voted Grand Champion among some 1,500 airplanes.

In flying competition, last December a Long-EZ, the VariEze's brand-new big brother, established a National Aeronautics Association world closed-course distance record for its class. Piloted by Burt's big brother, Dick, the Rutan plane covered 4,800.30 miles nonstop, emphatically eclipsing the twenty-year-old mark of 2,955.39 miles.

Rutan's fecund genius for coming up with new ideas that fly has been recognized by NASA, which asked him to test the theory that at transsonic speeds it is possible, even preferable, for a plane to fly with one wing swept forward and the other back. Rutan's AD-1 is currently trying its pivoting wing at Edwards Air Force Base, in California. Meanwhile, in a wind tunnel at Langley, in Virginia, NASA is testing a radical Rutan design for a big agricultural crop duster, dubbed Predator.

Almost as extraordinary as what Rutan does is the way he does it. Like a latter-day Wright brother, he invents airplanes obsessively and almost alone, collaborating only with a small cell of family and friends. Eight years ago, seeking solitude and low rent, Rutan set up shop on his own at Mojave Airport, a derelict, World War II surplus training field on the edge of the desert, 100 miles over the mountains from Los Angeles. At Mojave, Rutan's futuristic flyers share the concrete apron with obsolete hulks that have made their last landing on the way to the scrap heap. On some days when Rutan's planes aren't flying the only traffic on the field is the tumbleweeds blowing down the runway.

The hand-stenciled sign on the door proclaims RUTAN AIRCRAFT FACTORY, but the building is a corrugated metal prefab right out of the catalog, with an attached hangar not much bigger than a suburban garage. The entire permanent staff can go for a ride together in Rutan's five-seater Defiant with a seat to spare. Older brother Dick, recently retired from 20 years as an Air Force fighter pilot, is the outfit's chief mechanic and troubleshooter, test pilot, precision-flying instructor, wing commander, and Burt's alter ego.

Within Rutan's small world, collaboration is instinctively close and informal, with plenty of banter and inside jokes, but nonetheless intense and single-minded. Airplanes in general, and Rutan airplanes in particular, are a shared obsession; no one seems to have much time for anything else. Rutan's two marriages failed at least in part, he admits, because of his neglect; his wives were not airplanes.

He chafes at all kinds of distractions, even at his growing celebrity and the threat of big-time success. When aviation buffs and Rutan fans drop in at Mojave, he is likely to hide in the back room. Phone calls from would-be financial angels go unanswered. Normally friendly, he tells a journalist who has promised him color pages in a national magazine, "Every second I'm sitting here with you is a second I'm not out there testing my airplanes."

He won't even divert time or energy to manufacture airplanes from his own de-

Left: The prototype Defiant leads a VariEze and a VariViggen—Rutan's first, all-wood design—in tight formation over the Mojave Desert. Above: A 240-pound Quickie rests lightly under the wing of an earthbound Air Force behemoth.

signs, nor will he lease the designs to other manufacturers, for fear they will make compromises. Instead, he supports his research and development by selling plans to do-it-yourselfers who are so hell-bent on having Rutan airplanes that they build them at home in their garages and family rooms. In just three years, plans for the two-seater VariEze, Rutan's most popular design, have been bought by more than 4,200 flight enthusiasts. Of the first 100 to get their Ezes into the air, Rutan proudly points out, at least 10 are professional airline pilots, who presumably know a sweet airplane.

Rutan, now thirty-seven, started designing airplanes as a boy in California's San Joaquin Valley, winning local and state prizes for hot, sophisticated, radio-controlled models. He soloed for his pilot's license when he was sixteen, got a degree in aeronautical engineering from California Polytechnic State University, in San Luis Obispo, and went to work for the U.S. Air Force as a civilian test-flight engineer.

At the time, the Air Force's newest fighter, the F-4 Phantom, was plagued by a mysterious, lethal tendency to spin out of control and crash. More than 40 pilots were killed in such crashes, and some very expensive hardware was lost, causing the Pentagon considerable embarrassment. Riding in the backseat on dozens of test flights, Rutan figured out the problem and the proper compensating procedure. Then he went around the world to retrain every F-4 pilot. The F-4 is still a mainstay of the Air Force's fighter arsenal.

During seven years with the Air Force and two years spent designing planes for a kit maker, Rutan was already developing his first full-scale airplane. The VariViggen, a spruce-and-plywood two-seater he introduced to the homebuilders in 1974, is the direct descendant of a model he had built at Cal Poly nine years earlier. The Viggen signaled the debuts of Rutan as a full-fledged designer and of the unusual secondary, forward wing that has become the distinctive Rutan feature on all his subsequent designs. The stubby extra wing is called a canard, the French word for *duck*, possibly because it gives an airplane the long-necked look of a bird in flight.

Canard is also apt in its other sense of *hoax*, to designate a false wing. Earlier designers, beginning with the Wrights, used the canard not as a true wing but as a horizontal stabilizer, sometimes with a movable control surface, or elevator, much like the horizontal tail component of a conventional airplane. On the VariViggen, however, Rutan used the canard as a fully aerodynamic wing, sharing the lifting load with the larger, swept-back main wing in the rear. By suspending the aircraft between fore and aft surfaces instead of balancing it on a single wing amidships in the orthodox fashion, he gained two big advantages.

First, he was able to eliminate the elongated fuselage that serves conventional planes mainly as an arm to hold the tail surfaces. As a result, Rutan's planes are lighter, more efficient, and cheaper. His prototype Defiant, a five-passenger twin, for example, has only 60 percent of the drag-inducing "wetted skin area" of ordinary light twins, and 1,000 pounds less weight to carry around.

More important, the canard makes Rutan's planes virtually stall-proof. An ordinary plane stalls—loses its lift—when its wing meets the wind at too steep an angle, causing the smooth, laminar flow of air over the top surface of the wing to break away and become turbulent. The plane drops, out of control, until the angle between wing and wind is corrected or the aircraft hits the ground, whichever comes first.

Rutan eliminates the danger of a stall by mounting his canard wing at a slightly greater angle of incidence to the relative wind than the main wing. If his plane gets nose high, therefore, the canard approaches its stalling angle while the main wing is still flying strongly. As soon as the canard begins to lose lift, the plane's nose drops gently back to a safe attitude, restoring the canard to a flying angle. The main wing never has a chance to stall at all. The pilot can cruise with the stick pulled all the way back: The plane will fly comfortably, bobbing its nose gently as the canard tries to stall and recovers automatically. After doing their best to make a VariEze do its worst, two NASA test pilots reported officially that the plane is "virtually immune to stall-spin accidents."

The VariEze appeared in 1976 with another Rutan innovation: large, vertical fins on the main wingtips. Called Whitcomb winglets, after their inventor, the fins had already been tested on wind-tunnel models by NASA, but Rutan was the first to use them on a practical plane. Winglets are most effective on high-speed designs, but even on the 185 mph VariEze they "unwind the tip vortex," smoothing out the wingtip turbulence that limits the lifting efficiency of conventional wings. In effect, the smoother flow of air over the Eze's outer wing gives the plane the benefit of increased wingspread—and lift—without the proportional cost in structural weight and drag, resulting in a 6 percent fuel saving.

The winglets do double duty, acting also as vertical stabilizers in place of the conventional airplane's upright tail. As a result, the VariEze has extraordinary directional stability. It can be flown hands off even in turbulent air, and it tends to return to the straight and level from a banked attitude without prompting from the pilot. Nevertheless, the plane balances so delicately on the air that it can be banked into a turn by no more than a shift of the pilot's weight in the narrow cockpit.

For the VariEze Rutan also developed a novel construction that makes the plane an easy one for people to construct at home. Instead of the conventional plane's skin of riveted sheet metal over a skeleton of ribs and spars, Rutan built the Eze of seamless fiberglass saturated with epoxy resin, laid up in a six-layer sandwich over a solid core

CONTINUED ON PAGE 116

FIRESTARTER

CONTINUED FROM PAGE 53

closed committees come budget-renewal time. They have their pets in every department. Al Harrison, Wanless is their pet in the psych department."

"The administration doesn't mind?"

"Don't be naive, my boy. What's good for Wanless is good for the Harrison psychology department, which next year will have its very own building. No more slumming with those sociology types. And what's good for psych is good for Harrison State College. And for Ohio. And all that."

"Do you think it's safe?"

"They don't test it on student volunteers if it isn't safe," Quincey replied. "If they have even the slightest question, they test it on rats and then on convicts. You can be sure that what they're putting into you has been put into roughly three hundred people before you, whose reactions have been carefully monitored."

"I don't like this business about the CIA—"

"The Shop."

"What's the difference?" Andy asked morosely. He looked at Quincey's poster of Richard Nixon standing in front of a crunched-up used car. Nixon was grinning, and a stubby V for victory poked up out of each clenched fist. Andy could still barely believe the man had been elected President less than a year ago.

"Well, I thought maybe you could use the two hundred dollars, that's all."

"Why are they paying so much?" Andy asked suspiciously.

Quincey threw up his hands. "Andy, this is the government's treat! Can't you understand that?"

A week later he had received a letter telling him he had been accepted and asking for his signature on a release form. "Please bring the signed form to Room 100, Jason Gearneigh Hall, on May 6."

He went back over his answers on the release form, upward with the tip of his Bic. That was when someone tapped him on the shoulder and a girl's voice, sweet and slightly husky, asked, "Could I borrow that if you're done with it? Mine just went dry."

"Sure," he said, turning to hand it to her. Pretty girl. Tall. Light auburn hair, marvelously clear complexion, wearing a powder-blue sweater and a short skirt. Good legs. No stockings. Casual appraisal of the future wife.

He handed her his pen, and she smiled her thanks. The overhead lights made copper glints in her hair, which had been casually tied back with a wide white ribbon, as she bent over her form again.

He took his form up to the graduate assistant at the front of the room. "Thank you," the G.A. said, as programmed as Robbie the Robot. "Room Seventy, Saturday morning, nine o'clock. Please be on time."

She came out three or four minutes later, a few notebooks and a text under her arm. She was very pretty indeed, and Andy decided her legs had been worth waiting for. They were more than good; they were spectacular.

"Oh, there you are," she said, smiling.

"Here I am. I'm Andy, Andy McGee."

"I'm Vicky Tomlinson. And a little nervous about this, Andy. What if I go on a bad trip or something?"

"This sounds like pretty mild stuff. And even if it is acid, well . . . lab acid is different from the stuff you get on the street, or so I've heard. Very smooth, very mellow, and administered under very calm circumstances. They'll probably pipe in Cream or Jefferson Airplane," Andy surmised.

"Do you know much about LSD?" she asked with a little, cornerwise grin, which he liked very much.

"Very little," he admitted. "I tried it twice, once two years ago, once last year. In some ways it made me feel better. It cleaned out my head. At least, that's what it felt like. Afterward a lot of old crud just seemed to be gone. But I wouldn't want to make a steady habit of it. I don't like feeling so out of control of myself. Can I buy you a Coke?"

"All right," she agreed, and they walked over to the Student Union together.

He ended up buying her two Cokes, and they spent the afternoon together. That evening they had a few beers together at a local hangout. It turned out that she and her boyfriend, George, had come to a parting of the ways, and she wasn't sure exactly how to handle it. He had absolutely forbidden her to take part in the Wanless experiment. For that precise reason she had gone ahead and signed the release form, and she was now determined to go through with it even though she was a little scared.

The G.A. looped a piece of rubber around Andy's arm just above the elbow and said, "Make a fist." Andy did. The vein popped up obligingly. He looked away, feeling a little ill. Two hundred dollars or not, he had no urge to watch the injection.

Vicky was on the next cot, dressed in a sleeveless white blouse and dove-gray slacks. She offered him a strained smile. He thought again what beautiful auburn hair she had, how well it went with her direct blue eyes . . . then the prick of pain, followed by dull heat, in his arm.

"There," the G.A. said comfortingly.

"There yourself," Andy said. He was not comforted.

They were in Room 70 of Jason Gearneigh Hall, upstairs. A dozen cots had been tucked in, courtesy of the college infirmary, and the twelve volunteers were lying propped up on nonallergenic foam pillows, earning their money. Dr. Wanless gave none of the injections himself, but he was walking up and down between the cots with a word for everyone, and a little frosty smile. *We'll start to shrink anytime now,* Andy thought morbidly.

The graduate assistant was doing something else now. Ripping sound of cloth. Andy looked. No, it wasn't cloth, it was

tape. He was taping the hypo against Andy's arm. The needle was sticking into the bulging vein. Better not to look.

He glanced over at Vicky again instead. "How you doin', kid?"

"Okay."

Dr. Wantess had arrived. He stood between them, looking first at Vicky and then at Andy.

"You feel some slight pain, yes?" He had no accent of any kind, least of all an American regional one, but he constructed his words in a way Andy associated with English learned as a second language.

"Pressure," Vicky said. "Slight pressure."

"Yes? It will pass." He smiled benevolently down at Andy. In his white lab coat, he seemed very tall. His glasses seemed very small. The small and the tall.

Andy asked, "When do we shrink?"

Dr. Wanless continued to smile. "Do you feel you will shrink?"

"Shhhhrrrrink," Andy said, grinning foolishly. Something was happening to him. By God, he was getting high. He was getting off.

"Everything will be fine," Wanless said, and he smiled more widely. He passed on. Andy could look at the needle now. It didn't bother him now. *I'm a pine tree*, he thought. *See my beautiful needles*. He laughed.

Vicky was smiling at him. *God, she is beautiful!* He wanted to tell her how beautiful she was, how her hair was like copper set aflame.

"Thank you," she said. "What a nice compliment." Had she said that? Or had he imagined it?

Grasping the last shreds of his mind, he said, "I think I crapped out on the distilled water, Vicky."

She said placidly, "Me, too."

"Nice, isn't it?"

"Nice," she agreed dreamily.

Somewhere someone was crying. Babbling hysterically. The sound rose and fell in interesting cycles. After what seemed like eons of contemplation, Andy turned his head to see what was going on. It was interesting. Everything had become interesting. Everything seemed to be in slow motion. Slomo, as the avant-garde campus film critic always wrote in his columns. *In this film, as in others, Antonioni achieves some of his most spectacular effects with his use of slomo footage*. What an interesting, really clever word! It had the sound of a snake slipping out of a refrigerator: slomo.

Several of the grad assistants were running in slomo toward one of the cots that had been placed near the blackboard in Room 70. The young fellow on the cot appeared to be doing something to his eyes. Yes, he was definitely doing something to his eyes, because his fingers were hooked into them and he seemed to be clawing his eyeballs out of his head. His hands were hooked into claws, and blood was gushing from his eyes. It was gushing in slomo. The needle flapped from his arm in slomo.

Wanless was running in slomo. The eyes of the kid on the cot now looked like deflated poached eggs, Andy noted clinically. Yes, indeedy.

Then the white coats were all gathered around the cot, and you couldn't see the fellow anymore. Directly behind him, a chart hung down. It showed the quadrants of the human brain. Andy looked at this with great interest for a while. *Verry in-der-resting*, as Arte Johnson said on *Laugh-In*.

A bloody hand rose out of the huddle of white coats, like the hand of a drowning man. The fingers were streaked with gore, and shreds of tissue hung from them. The hand smacked the chart, leaving a blood-stain in the shape of a large comma. The chart rattled up on its roller with a loud snapping sound.

Then the cot was tilted (it was still impossible to see the boy who had clawed his eyes out) and was carried from the room.

A few minutes (hours? days? years?) later one of the grad assistants came over to Andy's cot, examined his needle, and then injected some more of its contents into Andy's mind.

"How you feeling, guy?" the G.A. asked, but of course he wasn't a G.A. He wasn't a student, none of them were. For one thing, this guy looked about thirty-five, and that was a little long in the tooth for a graduate student. And for another thing, this guy worked for the Shop. Andy suddenly knew it. It was absurd, but he knew it. And the man's name was . . .

Andy groped for it, and he got it. The man's name was Ralph Baxter.

He smiled. *Ralph Baxter. Good deal.*

"I feel okay," he said. "How's that other fellow?"

"What other fella's that, Andy?"

"The one who clawed his eyes out," Andy said serenely.

Baxter smiled and patted Andy's hand. "Pretty visual stuff, huh, guy?"

"No, really," Vicky said. "I saw it, too."

"You think you did," the G.A. who was not a G.A. said. "You just shared the same illusion. There was a guy over there by the board who had a muscular reaction . . . something like a charley horse. No clawed eyes. No blood."

He started away again.

Andy said, "My man, it is impossible to share the same illusion without some prior consultation." He felt immensely clever. The logic was impeccable, inarguable. He had old Ralph Baxter by the shorts.

Ralph smiled back, undaunted. "With this drug, it's very possible," he said. "I'll be back in a bit, okay?"

"Okay, Ralph," Andy said.

Ralph paused and came back toward where Andy lay on his cot. He came back in slomo. He looked thoughtfully down at Andy. Andy grinned back, a wide, foolish, drugged-out grin. *Got you there, Ralph, old son. Got you right by the proverbial shorts.* Suddenly a wealth of information about Ralph Baxter flooded in on him, tons of stuff. He was thirty-five, he had been with

the Shop for six years, before that he'd been with the FBI for two years, he had—

He had killed four people during his career, three men and one woman. And he had violated the woman after she was dead. She had been an A.P. stringer, and she had known about—

That part wasn't clear. And it didn't matter. Suddenly Andy didn't want to know. The grin faded from his lips. Ralph Baxter was still looking down at him, and Andy was swept by a black paranoia that he remembered from his two previous LSD trips . . . but this was deeper and much more frightening. He had no idea how he could know such things about Ralph Baxter—or how he had known his name at all—but if he told Ralph that he knew, he was terribly afraid that he might disappear from Room 70 of Jason Gearneigh with the same swiftness as the boy who had clawed out his eyes. Or maybe all of that really had been a hallucination; it didn't seem real at all now.

Ralph was still looking at him. Little by little he began to smile. "See?" he said softly. "With Lot Six, all kinds of funky things happen."

He left. Andy let out a slow sigh of relief. He looked over at Vicky, and she was looking back at him, her eyes wide and frightened. *She's getting my emotions*, he thought. *Like a radio. Take it easy on her! Remember, she's tripping, whatever else this weird shit is!*

He smiled at her, and after a moment Vicky smiled uncertainly back. She asked him what was wrong. He told her he didn't know, probably nothing.

(but we're not talking—her mouth's not moving)

(it's not?)

(vicky? is that you?)

(is it telepathy, andy? is it?)

He didn't know. It was something. He let his eyes slip closed.

Are those really grad assistants? She asked him, troubled. They don't look the same. Is it the drug, Andy?

I don't know, he said, eyes still closed. I don't know who they are. What happened to that boy? The one they took away? He opened his eyes again and looked at her, but Vicky was shaking her head. She didn't remember. Andy was surprised and dismayed to find that he hardly remembered himself. It seemed to have happened years ago. Got a charley horse, hadn't he, that guy? A muscular twitch, that's all. He—

Clawed his eyes out.

But what did it matter, really?

Hand rising out of the huddle of white coats like the hand of a drowning man.

But it happened a long time ago. Like in the twelfth century.

Bloody hand. Striking the chart. The chart rattling up on its roller with a snapping sound.

Better to drift. Vicky was looking troubled again.

Suddenly music began to flood down from the speakers in the ceiling, and that was nice . . . much nicer than thinking about charley horses and leaking eyeballs.

How much of it had been real, how much hallucination? Twelve years of off-and-on thought had not answered that question for Andy. At one point objects had seemed to fly through the room as if an invisible wind were blowing—paper cups, towels, a blood-pressure cuff, a deadly hail of pens and pencils. At another point, sometime later (or had it really been earlier? There was just no linear sequence), one of the test subjects had gone into a muscular seizure followed by cardiac arrest—or so it had seemed. There had been frantic efforts to restore him using mouth-to-mouth resuscitation, followed by a shot of something directly into the chest cavity, and finally a machine that made a high whine and had two black cups attached to thick wires. Andy seemed to remember one of the "grad assistants" roaring, "Zap him! Oh, give them to me, you fuckhead!"

At another point he had slept, dozing in and out of a twilight consciousness. He spoke to Vicky, and they told each other about themselves. They told each other things that a man and a woman don't usually tell each other until they've known each other for years—things a man and woman often never tell, not even in the dark marriage bed after decades of being together.

But did they *speak*?

"Ever have the kind of day when you sally forth from the cave convinced that, at the very least, you'll invent the wheel and instead get trampled by a dinosaur?"

That Andy never knew.

Time had stopped, but somehow it passed anyway.

The taxi let them off at Albany Airport. They went in, the little girl in the green pants and the red blouse, the big man with the shaggy hair and the slumped shoulders.

It was ten past midnight. The lobby of the terminal building had been given over to the early-morning people: servicemen at the end of their leaves, harried-looking women riding herd on scratchy, up-too-late children, businessmen with pouches of weariness under their eyes, cruising kids in big boots and long hair, some of them with packs on their backs, a couple with cased tennis rackets. The loudspeaker system announced arrivals and departures and paged people like some omnipotent voice in a dream.

Andy and Charlie sat side by side at desks with TVs bolted to them.

"Daddy, do I have to?" Charlie asked again. She was on the verge of tears.

"Honey, I'm used up," he said. "We have no money. We can't stay here."

"Those bad men are coming?" she asked, and her voice dropped to a whisper.

"I don't know." Thud, thud, thud in his brain. Not a riderless black horse anymore; now it was sacks filled with sharp scraps of iron being dropped on him from a fifth-story window. "We have to assume they are."

"How could I get money?"

He hesitated and then said, "You know."

The tears began trickling down her cheeks. "It's not right. It's not right to steal."

"I know it," he said. "But it's not right for them to keep coming at us, either. I explained it to you, Charlie. Or at least I tried."

"About little bad and big bad?"

"Yes. Lesser and greater evil."

"Does your head really hurt?"

"It's pretty bad," Andy said. There was no use telling her that in an hour, or possibly two, it would be so bad he would no longer be able to think coherently. No use frightening her worse than she already was. No use telling her that he didn't think they were going to get away this time.

"I'll try," she said, and she got out of the chair. "Poor Daddy," she said, and she kissed him.

He closed his eyes.

Little girl in green stretch pants and a red rayon blouse. Shoulder-length blond hair. Up too late, apparently by herself. She was in one of the few places where a little girl by herself could go unremarked after midnight. She passed people, but no one really saw her. If she had been crying, a security guard might have come over to ask her whether she was lost, if she knew which airline her mommy and daddy were ticketed on, what their names were, so they could be paged. But she wasn't crying, and she looked as if she knew where she was going.

She didn't, exactly, but she had a pretty fair idea of what she was looking for. They needed money, that was what Daddy had said. The bad men were coming, and Daddy was hurt. When he got hurt like this, it got hard for him to think. He had to lie down and have as much quiet as he could. He had to sleep until the pain went away. And the bad men might be coming—the men from the Shop, the men who wanted to pick Daddy apart and see what made him work, and to see whether he could be used, made to do bad things.

She saw a paper shopping bag sticking out of the top of a trash basket, and she took it. A little way farther down the concourse she came to what she was looking for: a row of pay phones.

Charlie stood looking at them, and she was afraid. She was afraid because Daddy had told her again and again that she shouldn't do it . . . since earliest childhood it had been the Bad Thing. She couldn't always control the Bad Thing. She might hurt herself, or someone else, or lots of people. The time

(oh mommy i'm sorry the hurt the bandages the screams she screamed i made my mommy scream and i never will again . . . never . . . because it is a BAD THING)

in the kitchen when she was little . . . but it hurt too much to think of that. It was a Bad Thing because, when you let it go, it went . . . everywhere. And that was scary.

There were other things. The push, for instance—that's what Daddy called it, the push. But she could push a lot harder than Daddy, and she never got headaches afterwards. But sometimes, afterwards . . . there were fires.

The word for the Bad Thing clanged in her mind as she stood nervously looking at the telephone booths: *pyrokinesis*, "Never mind that," Daddy had told her when they were still in that small upstate Pennsylvania town and thinking like fools that they were safe, "You're a firestarter, honey. Just one great big Zippo lighter." And then if had seemed funny, and she had giggled, but now it didn't seem funny at all.

The other reason why she wasn't supposed to push was that THEY might find out—the bad men from the Shop. "I don't think they know about you now," Daddy had told her, "and I don't want them to find out. Your push isn't exactly like mine, honey. You can't make people . . . well, change their minds, can you?"

"Noooo . . ."

"But you can make things move. And if they ever began to see a pattern, and connect that pattern to you, we'd be in even worse trouble than we are now."

And it was stealing, and stealing was also a Bad Thing.

Never mind. Daddy's head was hurting him, and they had to get to a quiet, warm place before it got too bad for him to think at all. Charlie moved forward.

Three booths from the end, a young man in a military uniform was sitting on the little stool with the door open and with his legs poking out. He was talking fast.

"Sally, look, I understand how you feel, but I can explain everything. Absolutely. I know

. . . but if you'll just let me—" He looked up, saw the little girl looking at him, and yanked his legs in and pulled the circular door closed, all in one motion, like a turtle pulling into its shell. *Having a fight with his girlfriend*, Charlie thought. *Probably stood her up. I'd never let a guy stand me up.*

Echoing loudspeaker. Rat of fear in the back of her mind, gnawing. All the faces were strange faces. She felt lonely and very small, grief-sick over her mother even now. This was stealing, but what did that matter? They had stolen her mother's life.

She slipped into the phone booth at the end, her shopping bag crackling. She took the phone off the hook and pretended she was talking—hello, Grampa, yes, Daddy and I just got in, we're fine—and looked out through the glass to see whether anyone was being nosey. No one was. The only person near was a black woman getting flight insurance from a machine, and her back was to Charlie.

Charlie looked at the pay phone and suddenly *shoved* it.

A little grunt of effort escaped her, and she bit down on her lower lip, liking the way it squeezed under her teeth. No, there was no pain involved. It felt *good* to shove things, and that was another thing that scared her. Suppose she got to *like* this dangerous thing.

She shoved again, very lightly, and suddenly a tide of coins poured out of the coin return. She tried to get her bag under them, but by the time she did, most of the quarters and nickels and dimes had spewed onto the floor. She bent over and swept as much as she could into the bag, glancing again and again out the window.

Then she went on to the next booth. The serviceman was still talking in the next booth up the line. He had opened the door again and was smoking. "Sal, honest to Christ, I did! Just ask your brother if you don't believe me! He'll—"

Charlie slipped the door shut, cutting off the slightly whining sound of his voice. She was only seven, but she knew a snow job when she heard one. She looked at the phone, and a moment later it gave up its change. This time she had the bag positioned perfectly and the coins cascaded to the bottom with a little jingling sound.

The serviceman was gone when she came out, and Charlie went into his booth. The seat was still warm and the air smelled nastily of cigarette smoke in spite of the fan.

More money rattled into her bag, and she went on to the next one.

Eddie Delgardo sat in a hard, plastic contour chair, looking up at the ceiling and smoking. *Bitch*, he was thinking. *She'll think twice about keeping her goddamn legs closed next time. Eddie this and Eddie that and Eddie I never want to see you again and Eddie how could you be so* crew-ull. But he had changed her mind about the old-I-never-want-to-see-you-again bit. He was on thirty-day leave, and now he was going to New York City, the Big Apple, to see the sights and tour the singles bars. And when he came back, Sally would be like a big ripe apple herself, ripe and ready to fall. None of that don't-you-have-any-respect-for-me stuff went down with Eddie Delgardo, of Marathon, Florida. Sally Bradford was going to put out, and if she really believed that crap about him having had a vasectomy, it served her right. And then let her go running to her hick schoolteacher brother if she wanted to. Eddie Delgardo would be driving an army supply truck in West Berlin. He would be—

Eddie's half-resentful, half-pleasant chain of daydreams was broken by a strange feeling of warmth coming from his feet; it was as if the floor had suddenly heated up ten degrees. And accompanying this was a strange but not completely unfamiliar smell . . . not something burning, but something *singeing*, maybe?

He opened his eyes, and the first thing he saw was that little girl who had been cruising around over by the phone booths, a little girl seven or eight years old, looking really ragged out. Now she was carrying a big paper bag, carrying it by the bottom as if it were full of groceries or something.

But his feet, that was the thing. They were no longer warm. They were *hot*.

Eddie looked down and screamed, "*Godamighty-Jeeesus!*"

His shoes were on fire.

Eddie leaped to his feet. Heads turned. Some woman saw what was happening and yelled in alarm. Two security guards who had been noodling with an Allegheny Airlines ticket clerk looked over to see what was going on.

None of which meant doodly-squat to Eddie Delgardo. Thoughts of Sally Bradford and his revenge of love upon her were the furthest things from his mind. His army issue shoes were burning merrily. The cuffs of his dress greens were catching. He was sprinting across the concourse, trailing smoke, as if shot from a catapult. The women's room was closer, and Eddie, whose sense of self-preservation was exquisitely defined, hit the door straight-arm and ran inside without hesitation.

A young woman was coming out of one of the stalls, her skirt tucked up to her waist, and she was adjusting her underalls. She saw Eddie, the human torch, and let out a scream that the bathroom's tiled walls magnified enormously. There was a babble of "What was that?" and "What's going on?" from the few other occupied stalls. Eddie caught the pay toilet door before it could swing back all the way and latch. He grabbed both sides of the stall at the top and hoisted himself feet first into the toilet. There was a hissing sound and a remarkable billow of steam.

The two security guards burst in.

"Hold it, you in there!" one of them cried. He had drawn his gun. "Come out of there with your hands laced on top of your head!"

"You mind waiting until I put my feet out?" Eddie Delgardo snarled. ∞

To be concluded next month.

mind

CONTINUED FROM PAGE 24

Ruth the control knob, and she signaled that the apparition of her daughter had turned down the volume.

Although the rest of us still heard the clicks, at that moment Ruth's auditory evoked response disappeared!

"That's a winner!" cried Peter.

"I knew I'd done it," Ruth said. "As a child at school, I used to turn off the teacher's voice so that when she talked, I'd see her lips moving and not hear her speaking. I also remember watching my mother's mouth move and not hearing a word she was saying. She'd say to me, 'Repeat what I've just said,' but I couldn't."

How had Ruth managed to block her visual and auditory evoked responses? Dr. Fenwick and I concluded she probably had an unusually keen ability to focus her attention on one image while shutting out everything else around her.

Our results showed that when Ruth was seeing and hearing an apparition, her brain reacted as it would when perceiving a live person. I recalled a teacher of mine once saying, "Nature never creates just one instance of anything," and concluded there must be other people whose brains have similar capabilities.

How frequently do such experiences occur? The best information comes from a census conducted between 1889 and 1892 by a committee of the Society for Psychical Research in England, which asked 17,000 people to answer Yes or No to this question: "Have you ever, when believing yourself to be completely awake, had a vivid impression of seeing or being touched by a living being or an inanimate object or of hearing a voice, which impression, so far as you could discover, was not due to an external physical cause?"

About one in ten answered Yes. Some respondents reported more than one such experience. In the *Report of the Census of Hallucinations*, the researchers argued persuasively that the respondents composed a fair sample and that the statistical proportion answering Yes would be 10 percent for the general population.

Under what circumstances do apparitional experiences occur? No one knows, but there is some evidence in Ruth's case that she tended to slip into trances, unaware, and in those trances was likely to hallucinate.

The story of Ruth suggests the possibility that a symptom such as her vivid hallucinations can best be seen as expressing an unrecognized talent, not a handicap. Perhaps various mental and even physical disorders are manifestations of capabilities that patients could learn to exploit. ∞

Morton Schatzman is an American psychiatrist who lives and practices in London. His experiences with apparitions are detailed in his book The Story of Ruth.

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CONTINUED FROM PAGE 87

Kantrowitz: Uncertainty is nothing new. We've always lived with it. What is new is that now the uncertainty is phrased in scientific language so that people who don't mind crossing a busy street have to decide whether they want to share in a .007 probability of six cancer deaths in a population of a hundred thousand or whatever. Still, the plea for absolute certainty—a certainty human beings can never have—is a plea for a death sentence. You just can't live that way.

The same is true of irreversibility: We're often told that we're about to let a genie out of the bottle, open Pandora's box, and so forth. We've always lived with irreversibility, too. You couldn't have reversed the discovery of fire.

Omni: Change is so rapid today that many people tend to idealize the past, to think that we lived in perfect ecological harmony up until the Industrial Revolution.

Kantrowitz: It's a persistent myth, from Genesis to Jean-Jacques Rousseau: the psychology of Eden. And its counterpart is an imagination of disaster. There's a book by a British antitechnologist called *A Thousand Disasters*, all of them since World War II. To me, a disaster is something like that war itself, or the Black Death. Yet many people would rather imagine some recombinant-DNA plague than consider how public-health technology and biology have eliminated one real plague after another.

The roots of the antitechnological attitude go deep. You can see them clearly in Dostoevsky's *Notes from Underground*, where there's a polemic against the constraint imposed by the fact that $2 \times 2 = 4$. Dostoevsky had had some engineering training in his youth in St. Petersburg, and I can imagine the cut-and-dried, $2 \times 2 = 4$ view of science that he got—and rebelled against. It's a rebellion I fully understand and endorse, but it's a rebellion against a phony, fossilized, dead version of science, not the living process that has led us to non-Euclidean geometries much stranger than $2 \times 2 = 5$!

Omni: Wasn't Dostoevsky's contemporary Marx optimistic about science and technology?

Kantrowitz: Very much so. If Marx could hear some of the antitechnological statements made by his ideological heirs in the Western world, he'd be shocked. There's no reason why politics should make one antitechnological; instead, they should make one concerned with the democratic governance of technology. It's no use pretending we can live in the twentieth and twenty-first centuries without a vigorously advancing technology.

Omni: Maybe the difference is that Marx was still able to see science as revolutionary, while many people today associate it with governments, industry, and weapons. Take the laser, whose applications you've been exploring for a long time: Most of the R and D on lasers now seems to have military overtones.

Kantrowitz: That's because we've backed off from the other possibilities. If we had the atmosphere of adventurous technology today that we had fifteen years ago, we'd be taking very seriously the other opportunities presented by high-powered lasers, especially laser propulsion. I'm no more than an advocate for laser propulsion; I'm not qualified to judge it against all the other options. But it has at least a good chance of being overwhelmingly superior for certain applications.

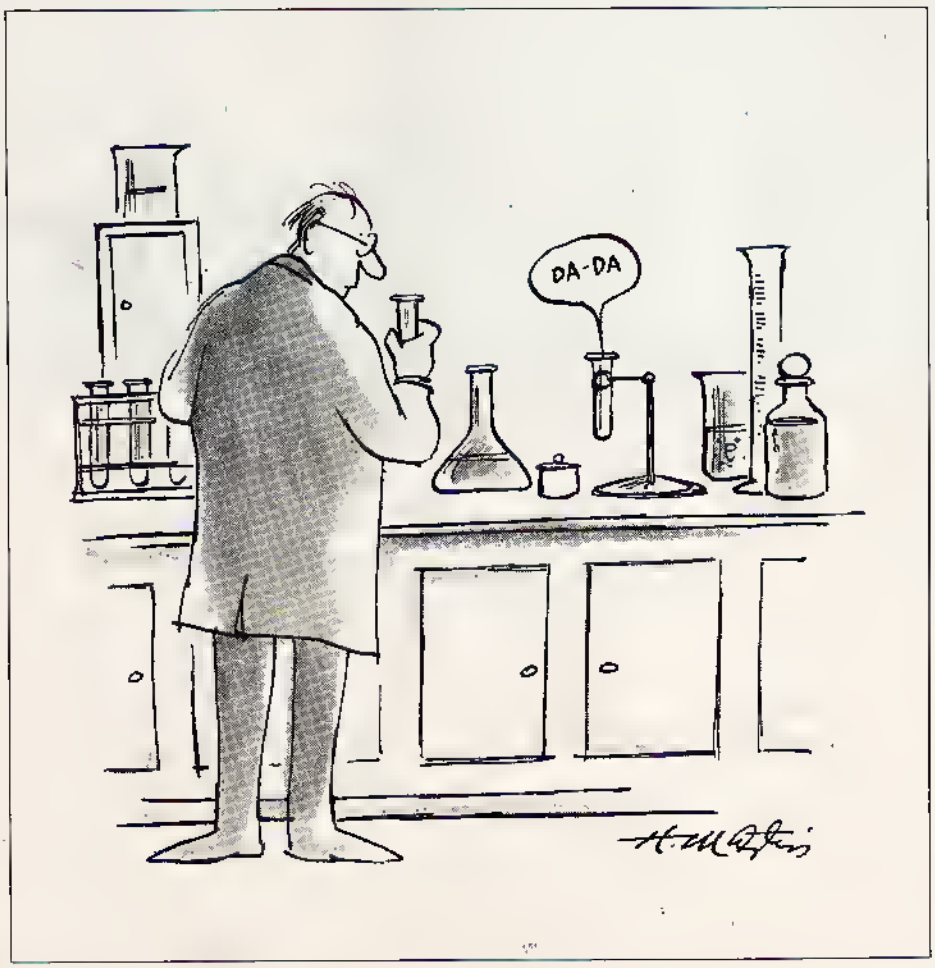
Consider the proposal that we dispose of nuclear waste by shooting it into the sun. To do that, let's say you'd insist on no more than one chance in a billion that the process would fail and spread the waste around. You might get it by running two series of one hundred thousand tests, each, the first series launching dummy payloads into orbit, the second series with a reentry vehicle to make sure that even if the process aborted, the wastes would not escape.

How expensive would such a test program be? Not very, if you had laser propulsion. I'm pretty sure you couldn't afford it with rockets, even if they were reliable enough.

Omni: Your MIT colleague Henry Kolm has suggested that the same nuclear-waste disposal scheme could be carried out using an electromagnetic launcher. It would send telephone-pole-sized waste capsules up through the atmosphere so fast that their casing would blaze like a meteor. After calculating the power needs and costs involved, Kolm concluded that "it might well be a very reasonable thing to do." Somehow I have the feeling that it's not going to be easy to convince people of that.

Kantrowitz: The reason it seems unreasonable has nothing to do with the idea's technical promise, but rather with the fact that technical expertise has lost credibility. I'm not certain that my idea is a good one—or that Kolm's is—but I'm certain that we can't go on with a situation in which technical issues are settled by prejudice rather than critical examination. So Kolm's proposal, my proposal, should be examined by expert adversaries who know as much as we do about lasers, launching and reentry dynamics, and so on. Such a cross-examination could be thoroughly scientific, while at the same time showing a decent respect for the way society at large resolves its conflicts.

I wish I knew of a better way to proceed, but I don't. I've heard the suggestion that we should mediate these issues, trying to achieve a placid atmosphere in which people will give and take. The trouble is that in mediated negotiations each side gives a little bit in ways that will hurt its



cause least. You don't know that society's best interests are served by those compromises, because the procedure is inarticulate. You don't know why your opponent gave in on this point rather than on that one. I don't want a consensus at all costs; I want to know the facts.

Omni: So you trust the revelatory power of arguments aimed at victory more than that of negotiations?

Kantrowitz: Exactly. I respect the power of the adversary procedure to bring out what Oliver Wendell Holmes called the "inarticulate major premise." These premises are all around us in issues of science and technology, and they are exactly what the Science Court is intended to unearth.

Omni: How much luck have you had in persuading other scientists to back the idea?

Kantrowitz: I set out some time ago to persuade two good friends of mine, Hans Bethe and Edward Teller, that the Science Court was needed. You can't find two people more dedicated to their own separate versions of what's good for the United States, whether they're in agreement, as on nuclear energy, or on opposite sides, as on disarmament.

When I was running the Everett lab, I had a custom of dining with Hans once a month or so, and I kept urging the idea on him. At first he found it difficult to accept because he had devoted himself so much to using his scientific prestige for good in the world. After a while, though, perhaps because of the growth of antinuclear-power sentiment, he came to see that he needed the court.

Edward—well, Edward is a delightful person, but it's very hard to get him to listen to you. I hadn't been able to make an impression on him in many private conversations, but I didn't give up. Then he invited me to give a talk at the Livermore Laboratory [in California], and I agreed, on the condition that he would introduce me to the audience. That way he'd have to stay and listen. I went on for an hour about the Science Court, and after that he was persuaded.

I'd also like very much to persuade Philip Morrison of the importance of the Science Court. He'll agree it's a good idea; he'll sign a letter or petition for it. But to bring his power to bear—and I mean not his influence, but his intellectual power—on this matter (which to my mind is as important as the disarmament issues he's working on) would be wonderful.

Omni: Do you ever get discouraged about the prospects of success? It's been more than fifteen years since you began, and certainly there are many more public issues involving science and technology, but progress is still slow.

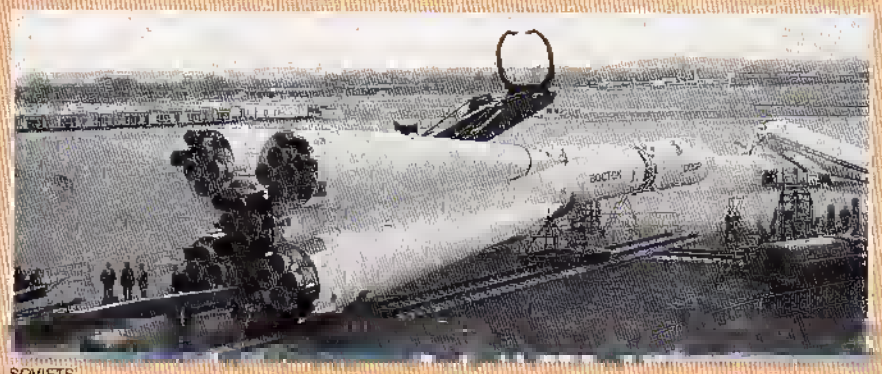
Kantrowitz: No, I'm not at all discouraged. The need for innovative ways of managing technology keeps growing—and it seems to me that more and more people are willing to tackle that problem, whether through the Science Court or some other mechanism.

Omni: Thank you, Dr. Kantrowitz. ∞

NEXT OMNI

ISOLATION

ILLUMINATIONS



SOVIETS

SOVIETS IN SPACE—Did you know that the Russians are developing a space shuttle of their own? That their killer satellites will soon be able to knock out our orbiters? That they have a new generation of space stations nearly ready for use? Neither did NASA. Preoccupied with Iran, Afghanistan, and other trouble spots, our intelligence community has forgotten that the Soviets take space development very seriously. Aerospace writer Craig Covault remembers, however. His startling account of Russia's determined move into orbit appears in next month's *Omni*.

THE ELECTRONIC CHURCH—Praise the Lord and don't change the channel! Evangelical Christianity has taken to the airwaves in a powerfully persuasive, Space Age style. Millions of dollars and the attitudes of 100 million Americans are controlled by the slickly produced, satellite-borne programs of the new video preachers, who reach more believers than churches ever did. Will ministers of the future put the word of Nielsen before the Word of God? Find out in August's *Omni*.

ISOLATION TANKS—Is rummaging around in the darkness of the soul good for you? Follow writer John Gorman as he enters the soft, black world of the isolation tank, where humans float sightless and weightless to confront their inner selves. For some the tank is like a womb, for others a tomb. For American astronauts it simulated the emptiness of space. Scientists feel isolation tanks may represent an important new treatment for stress and anxiety. Next month *Omni* reveals why this ultimate development in sensory deprivation may help you cope with tomorrow.

URBAN ILLUMINATIONS—In August *Omni* shows how today's urban landscape is converted into stunning, articulate light art of the future. Photographer Dudley Gray and light sculptor Joe Strand combine their creative talents to transform buildings, bridges, and statuary into chains of light and geometric metaphor. Using Klieg lights, rather than bricks and mortar, Gray/Strand create memorable cityscapes of color and light. Tomorrow can become, by their technological devices, really today.

SCIENCE FICTION—The exciting conclusion of a two-part excerpt from Stephen King's novel *Firestarter* highlights our August selection. Also appearing will be a short story by William Kotzwinkle, an author not usually associated with science fiction. "The Curio Shop" is a delightful exception. *Omni*'s fiction editor, Robert Sheckley, invites readers to share a pleasant future in "The Future Lost."

PLATFORM

CONTINUED FROM PAGE 90

money from other fields of biomedical research. Then, without warning, he abolished the White House science office, contending that his presidency didn't require on-board science advice.

Gerald Ford, warned that Nixon's budget cuts—compounded by inflation—had left American science in a shaky condition, sought big budget boosts each year to rebuild the financial health of basic research. Ford, in collaboration with Congress, also reestablished the White House science office, thus restoring science's influence in presidential circles.

Jimmy Carter came to office undecided about whether he wanted a science adviser at all. Three months went by before he filled the post. Yet after this slow beginning he has carried on Ford's budget policies for science and has also acted to establish closer links between R&D in industry and academe.

From Eisenhower through Carter, these science-related actions all had major impacts, both on the scientific community and on the application of science and technology to such international concerns as regional economic development, health, and education. Yet none of these steps—including such vast endeavors as the moon-landing program and the war on cancer—received any notice during the election campaigns that preceded their unveiling. Why?

One major cause is the illusion of "expertism," the belief that scientific and technical issues are so complex that ordinary people can't intelligently judge them. Closely connected is the feeling that scientific issues are different, that they should be decided according to objective technical criteria rather than by the horse swapping of conventional politics.

In a practical sense, however, it almost doesn't matter why virtually all candidates for our highest elective office choose to avoid science and technology. Their negligence, whatever its cause, is too costly to science and to the nation by and large. *Omni* believes the voters must compel the candidates to face up to these issues. We don't expect candidates to work out the day-to-day management of R&D. But on the major issues of priorities, social values, scope of resources, and the responsibility of government to assist financially strapped universities and their research programs, we strongly believe that the candidates must be explicit.

We've spent the past three months consulting with key figures in science and politics and examining the voluminous records of congressional committees and other public bodies. From this inquiry we've distilled what we believe are the ten most important issues in contemporary science and technology and their relations with the government. We've spelled out these issues in detail, and to each we've appended a brief plank. We hope the following *Omni* Science Platform will encourage a long-overdue discussion of these issues by the contenders for the presidency:

• Unpredictable, frequently inexplicable, fluctuations in government support are a continuing plague on science and technology. Research projects often take years to complete, but the government sets budgets from year to year, buffeted by congressional elections every two years and a race for the White House every four. Abrupt financial ups and downs emerge from this erratic process to jeopardize or derail valuable research.

In late March a sudden budget-cutting decree from President Carter threw the National Science Foundation into such turmoil that letters offering fellowships to 70 promising graduate students were yanked from the mail room minutes before they were to go out. Though mathematics is central to all the sciences, government support for this field has actually declined in purchasing power over the past decade. Support for engineering—which is heavily dependent on math—went up.

It is impossible to link these shifts to any rational process, national needs, or circumstances in the disciplines. Between centralized planning and what now borders on chaos, we must find a middle area.

Our platform plank: To avoid disruptive and wasteful fluctuations in government support for R&D, supporting agencies should be funded more than one year at a time. They, in turn, must commit themselves to support projects until work is complete.

• Red tape, under the bureaucratic banner of strict accountability for government funds, has grown far beyond any need. Paperwork requirements make it nearly impossible for scientists to revise their plans as they gain new knowledge after submitting their research proposals; any major revision must be approved by the supporting agency.

Harold Agnew, former chief of the Los Alamos Scientific Laboratory, in New Mexico, expressed the feelings of many researchers several years ago when he said, "The ever-increasing bureaucracy, composed of managers who require more and more detail, justification, and guaranteed schedules, will in the not-too-distant future completely eradicate our nation's world position in research and technology."

Our platform plank: Drastically reduce the paperwork that the federal government requires of the scientific community.

• Universities, the home of most of our basic research, have stopped growing and will not expand again for many years. This has sharply limited opportunities for young researchers to begin their scientific careers. The National Research Council (NRC) estimates that the shortage of openings is relatively small; perhaps only 600 more positions a year for the next 15 to 20

years would be needed to maintain a healthy flow of young Ph.D.'s into the universities.

The council has a modest prescription for the problem, a long-term program of Research Excellence Awards designed to launch the careers of promising young scientists whose opportunities are now limited by the dearth of academic openings. The total cost would be only $381 million over the next 20 years.

Our platform plank: The federal government, in its own interest, should fund a program similar to the NRC's proposal for the duration of the current slowdown in academic hiring.

• Tight budgets have made the American scientific community very cautious in recent years. Doctoral students seek out low-risk research topics because long projects and blind alleys can sabotage a career before it begins. This conservatism extends to the agencies that support research; the bureaucrats in charge don't want to risk having supported a far-out project that falls on its face.

Scientists, however, have made some of their most notable advances by bucking the tide, by not playing it safe. What's needed, then, is explicit recognition that long-shot research is important and must be backed by the money to support it.

Our platform plank: To stimulate creative research, each federal agency must set aside 1 or 2 percent of its basic research budget for innovative projects outside the bureaucratic mainstream.

• The federal government has made the scientific community entirely too dependent on Washington's whims. We need to diversify the support of science. Our best chance may be to enlist private industry, which once performed much basic research and heavily supported science in the universities.

Our platform plank: Devise tax incentives that encourage industry to spend more for scientific research.

• Abrupt budget cuts and policy shifts have crippled the space program. The need to siphon funds from other projects to compensate for delays in the space shuttle project has worsened an already-serious situation. Space research is now at an all-time low. Understandably, researchers and their organizations have little interest in staking their futures on our moribund space effort. Their reluctance is accelerating the loss of our space capabilities. What's needed is a firm policy that combines growth and predictability.

Our platform plank: The importance of space for our national security and general well-being dictates that we expand the space program, assure it long-term support, and insulate it against disruptive changes in its budget.

• In an era of slow growth or no growth, the nation cannot afford to distribute its scientific resources according to pork-barrel politics. Yet the aging of existing facilities and the development of new scientific instruments now force us to reequip much of American science. We must accept the fact that a few large scientific facilities are more effective than many small ones.

Our platform plank: Government agencies should fund national centers for especially expensive equipment and regional centers for less costly facilities.

• Solar energy could contribute much to solving the nation's energy dilemma. Once the equipment has been built, it is pollution-free, immune to foreign disruption, renewable, and versatile. Though funds for solar research have increased markedly in recent years, this technology has not been pursued with the intensity and resources it clearly warrants.

Our platform plank: The federal government must promote solar energy in all possible ways, from supporting basic research to developing solar technologies and creating tax incentives for their installation.

• Research related to national security performed by the Defense Department, NASA, and the Department of Energy consumes more than half of all government research funds. In past decades spin-offs of this research have helped feed the civilian economy. Commercial aviation, solid-state physics, and materials science all benefited significantly from defense funding. Recently, however, military research and civilian needs have had relatively little to do with each other. Military-research managers, hard pressed to stay within their budgets, have made little effort to spread their technologies to the civilian economy.

Our platform plank: Stimulating the national economy should rank among the top priorities of the national-security research effort. Programs should be devised to ensure that findings of potential value swiftly enter other sectors of the economy.

• Science and technology have done much to solve the problems of developing nations, especially in areas of public health, agricultural productivity, industrialization, and education. Yet the United Nations Conference on Science and Technology for Development, held in August 1979 in Vienna, showed that science could do far more to ease hunger and poverty. The United States pledged at that conference to establish a research institute to collaborate with developing nations. Congress has blocked the idea, however.

Our platform plank: Science and technology are an integral part of our efforts to aid the economies of developing nations. We must strongly support any effort to focus American research on this goal.

There you have it: the *Omni* Science Platform. We ask the candidates to examine these issues and invite them to incorporate our planks into their own platforms. At the very least, each candidate must explain just what he will do to help science fill its vital role as the wellspring of our nation's intellectual and economic vigor. Our next President must come to grips with these issues. We have the right to know what science policies we are voting for. ∞

SPACE

CONTINUED FROM PAGE 22

might imagine: enormous tidal waves battering shorelines, climate changes that would wipe out major food-growing areas, and countless thousands of square kilometers leveled and burned. Civilization as we know it might cease to exist. A hydrogen-bomb war might not be much more harmful.

In studies of nuclear-power-plant safety, where the probability of a catastrophic accident is very low, the severity of consequences is usually held to demand extraordinary preventive measures. Regardless of which side of the nuclear-power issue we are on, most of us agree that making existing plants as safe as possible is well worth the cost. By similar logic, Taylor suggested that $1 billion spent to prevent an asteroid fall may be justified by the trillion dollars of cleanup such a disaster would require—if the damage could be healed at all.

So what can we do to prevent an asteroid cataclysm? The answer is, Be prepared to divert an asteroid. We would need to develop a system that could alter the path of an asteroid away from Earth, given only a few days' notice (though we might have more warning if the asteroid's orbit were already known). Rockets might do it, or precisely directed thermonuclear explosions. Remember, we are now talking about serious, undramatic engineering.

Indeed, these are the same kinds of systems we'd use to import asteroidal resources. They have already been studied as a way to reduce the limits to growth here on Earth, build permanent space settlements, and construct the ships in which we could explore the solar system and universe beyond. One more reason has been added to open up what I call the fertile stars: That ounce of protection that might avert the destruction of civilization itself might grow out of the technology necessary to retrieve asteroids.

All too often we do the right things, such as acting to improve the human condition, only for reasons as questionable as the fear of an improbable cataclysm. In our irrationally ordered world, the threat of another Tunguska—this one in a populated area—may be what it will take to spur the world's governments to action.

About 2 billion years ago, probably before life appeared on Earth, a fair-sized asteroid crashed into the plains of Ontario, not far from the mining town of Sudbury. It's a mining town because about half of the world's nickel comes from the large, circular crater formed by the impact. Geologists disagree about whether this rich cache of nickel and iron is literally extraterrestrial or whether the impact simply excavated the subsurface ore. We may unwittingly have been mining a fertile star already.

Whether or not we go to the asteroids, they'll come to us. Will we be ready? ∞

RARE BIRD

CONTINUED FROM PAGE 104

of rigid plastic foam. The builder simply carves the core from foam blocks with a hot wire, trims it with a kitchen knife, and smooths it with sandpaper. The fiberglass is cut from rolls with ordinary scissors, like dress fabric, and the epoxy resin goes on with a paintbrush.

Rutan estimates that an ordinarily talented builder can put a VariEze together from scratch in a year of weekends—a total of fewer than 1,000 man-hours. A complete set of plans and instructions, originally $95, can now be had for about $200 from the Rutan Aircraft Factory. The raw materials for the airframe and the essential prefabricated parts cost about $5,000. With a rebuilt, 85 hp Continental engine and a wooden propeller, the total cost of the Eze comes to about $7,500, give or take $1,000, no more than the price of a modest automobile. For his investment of time and money, the happy homebuilder gets a visionary flyer that will cruise at close to 200 mph for 750 miles or more and get about 35 miles to a gallon of gasoline. For about the same money, the brand-new Long-EZ has four feet more wingspread, carries more fuel and payload, takes up to a 115 hp engine, and will fly 1,700 miles in about nine hours without coming down for gas.

The solo flier who wants the most for the least might go for Rutan's Quickie. Designed, built, and tested during a few months in the summer and fall of 1977, the Quickie was inspired by a two-cylinder, four-stroke engine weighing 104 pounds and developing 16 horsepower, intended for light machinery and garden tractors. To make it fly, Rutan had to mount the engine in an airplane of extraordinary lightness, aerodynamic efficiency, and economy. He had no excess horsepower to spend on unnecessary weight or drag.

Rutan's solution is a single-seat, single-engine, foam-and-fiberglass airplane that weighs 240 pounds, engine and all. The Quickie can be picked up by the tail and wheeled around on its landing gear as easily as a shopping cart; yet it will carry a useful load of pilot and fuel equal to its own empty weight, cruise at 125 mph with its improved engine, and go 80 miles on a gallon of gasoline.

The Quickie was hardly airborne when Rutan sold his interest in the project to his partners to devote himself to a much more ambitious airplane: a five-passenger, twin-engine version of the VariEze, aptly named Defiant. The Defiant for the first time puts Rutan in competition with the big names in small planes for the very richest part of the booming general-aviation market.

"We had one idea," Rutan says. "To make a twin-engine plane that would be high-performance, low-cost, and safe. Those three qualities had never been combined in a single airplane before." Inheriting all the VariEze's aerodynamic virtues, the prototype Defiant easily outperforms the best conventional light twins. Compared to Grumman's new Cougar, for example, a Defiant climbs and cruises 20 percent faster, with a maximum climb rate of 2,000 feet per minute and a top cruising speed of about 200 mph. Carrying five adults and baggage, a Deliant can go 1,500 miles on a tankful of fuel, more than twice the range of the Cougar with only four passengers. Rutan figures that a production version of his plane could be factory-built today to sell for about $70,000, well below the prices of conventional light twins.

For safety, too, no conventional twin can touch the Defiant. Like the single-engine Eze, the Defiant is inherently extremely stable, stall-proof, and responsive, thanks to its canard and winglets. In addition, on his very first twin Rutan completely eliminated the inherent safety problem of all conventional twin-engine configurations.

With engines mounted symmetrically on the wings, the conventional twin that loses power from one engine suddenly becomes underpowered and wickedly unbalanced. Even under ideal conditions it takes superb piloting to keep the crippled plane in the air and under control. If the power loss occurs right after liftoff, however—and statistics show it usually does—when the plane has only a thin cushion of altitude and a narrow margin of airspeed, the odds become hard to beat. The pilot, as pilots say, buys the runway.

"The things that a pilot has to do in a conventional twin," Rutan says, "there aren't even knobs for on this airplane." Instead of putting the Defiant's twin 160 hp Lycomings on the wings, Rutan mounted them "in line" along the central axis, one pulling the plane by the nose, the other pushing from behind the rear seat. If one engine conks out, therefore, the pilot does not have to wrestle with an asymmetrical thrust that is trying to wrench the plane out of the air.

Rutan's five-passenger twin weighs no more than conventional single-engine planes powered by the same Lycoming engine. Even on half-power, the Defiant can continue its takeoff, climb, and even turn, without any emergency procedures.

Rutan's next step will be to translate the handcrafted Defiant prototype into a production airplane that can be factory-built. He is ultimately resigned to turning the design over to be manufactured by someone else, or by some new company, diluting his control. "I want to keep the plane for myself for a while, as long as I can," he says wistfully. He will settle for absolute control of the Defiant until it has been certified for commercial production by the Federal Aviation Administration. Then the design, down to the last detail, will be frozen in regulatory ice. Anyone who meddles with it will have to deal with the Feds. ∞

Information and plans for Burt Rutan's airplanes are available from: Rutan Aircraft Factory, Building 13, Mojave Airport, Mojave, CA 93501.

BOOKS

CONTINUED FROM PAGE 26

definitely shifted our focus toward doing first hardcover editions of modern science-fiction novels." The second Gregg series, 30 titles released in 1976, reflects Hartwell's intention with books by Brian W. Aldiss (*Hothouse*), Samuel R. Delany (*Babel-17*), Leiber (*The Big Time*), Moorcock (*The Final Programme*), Jack Vance (*The Dragon Masters*)—all first hardcover editions. Along with these came David Russen's *Iter Lunare*, of 1703, Stanley Waterloo's 1898 *Armageddon*, and other esoterica, but the pattern was already evident in the earlier series.

More recently Gregg has specialized in multivolume sets by popular authors—the only Gregg titles that feature orthodox book jackets. The Witch World series was the first of these, followed by Leiber's beloved Fafhrd and Gray Mouser stories, in six volumes, Asimov's little-known David Starr space-adventure series, another Norton set, and a big Anderson package. Though the mainstay of the line is these facsimile reprints of paperbacks and out-of-print hardcovers, there have been occasional original books as well: anthologies of nineteenth-century treasures, a volume dealing with the making of the 1950 Heinlein movie *Destination: Moon*, and an Anderson collection.

Hartwell and Currey have a long list of titles that they plan to reprint at the present pace of 20 or 30 a year. One project just launched is a reissue of the famed Winston Science Fiction Series of juvenile novels that delighted young readers a generation ago. A Heinlein series is being developed as rights become available, and more Norton books are slated. With hundreds of titles available or in preparation, Gregg is one of the busiest SF publishers.

But the editions remain minuscule, anywhere from 300 to 1,250 copies, with the average print run at about 500. Many of Gregg's titles sell out at once and become instant collector's items. These are reissued in small additional printings. The more esoteric items are slower to move; however, unlike bigger houses, Gregg can tolerate sales of only one or two copies a month of an obscure title, and only a couple of Gregg editions go out of print.

And so the books march serenely from the press—*The Worlds of Fritz Leiber*, 22 short stories with an introduction by Leiber's son, Justin; *The Fantasies of Harlan Ellison*, with introductions by Ellison and Moorcock; and Robert Sheckley's *The Tenth Victim* (inflated, for its movie version, from Sheckley's original title of "Seventh Victim"), and much more, in sturdy, luscious buckram. "Gregg Press is where old science fiction goes to die," one cynical writer—himself represented by several Gregg titles—has said. But right now this odd company looks like one of the most vigorous of SF publishing houses. ∞

FUZZ BUSTERS

PEOPLE

By Dick Teresi

Throughout most of March and April at the U.S. district court in Los Angeles, **Ben Bova**, *Omni*'s executive editor, and **Harlan Ellison**, the well-known writer of speculative fiction, were engaged in litigation against the ABC television network and Paramount Pictures for copyright infringement.

In 1969 Bova and Ellison wrote a short story together called "Brillo," partnering a veteran street cop with a man-sized, fireplug-shaped experimental robot. The piece was published the following year in *Analog* magazine. The "Brillo" name comes from a play off the robot/cop idea. Late-Sixties police were occasionally called *fuzz*; the robot was metal. Metal fuzz—hence, "Brillo." Needless to say, both writers have apologized frequently for the bad pun.

But not for the story. Both of them thought it had potential as a TV series. Ellison, who had worked in TV for 15 years, was approached by an independent production company, which presented Bova and Ellison's idea to ABC. The network ordered a teleplay. So far, so good.

Time passed. For reasons unclear at the time, ABC dropped the "Brillo" project. Other than natural disappointment, neither writer thought much of this event. Television networks frequently drop projects at various stages of development. Then, early in 1976, ABC aired a show, produced by Paramount and starring Ernest Borgnine, called *Future Cop*, a police pilot partnering a veteran street cop with an experimental robot, in this case a humanoid robot portrayed by an actor. Bova and Ellison sued for copyright infringement. Almost four years later, they got their day in court.

Aside from the immediate legal issues, the case potentially has significance for science-fiction writers. Essentially, what Bova and Ellison were trying to protect was the milieu of their story, the background world it creates. Unlike stories with a contemporary or historical setting, stories set in the future rely for much of their effect on the creation of extensively detailed backgrounds.

Because of the special aspect of the case, much of the testimony was given by expert witnesses, writers such as **Frank Herbert** (*Dune*), **Norman Spinrad** (*The Iron Dream*), and **David Gerrold** (*When Harlie Was One*), and even critics and academics such as **David N. Samuelson** and **George Guffey**. An ironic twist to the trial came when Guffey, a Renaissance literature scholar who testified for the defendants, attributed much of his expertise in analyzing science-fiction teleplays to an essay he read by Harlan Ellison, one of the plaintiffs.

Unfortunately for the jurors, many of the trial's more colorful moments occurred outside their hearing. During a colloquy between the plaintiffs' counsel and the court concerning whether a witness could testify that *Future Cop* was not science fiction because androids are already among us now, **Judge Albert Stevens** conceded that he would certainly like to hear someone testify to the belief that there are people who are walking about with "electronic gizzards." His Honor, by the way, is an inventor himself and holder of several patents. He considers his best invention the "Tipsy Fence." By day it's a partition dividing off one area of a backyard from another; by night it tips down horizontally to become the world's longest bar.

The bon mot award for the trial has to be shared by Ellison and **John Davies**, the chief defense counsel for ABC/Paramount. During a lunch break Ellison and Davies found themselves on opposite sides of the square adjacent to Olvera Street, in the heart of the Chicano barrio. Ellison, seeing Davies, thrust out an accusing arm and shouted, "Stop that man! He's the one who tried to assassinate Cesar Chavez!" Later Ellison apologized for his joke. Davies was unflustered, saying the remark in no way offended him. Indeed, he claimed several people in the neighborhood had asked for his autograph.

The verdict? For the plaintiffs—$337,000, roughly half compensatory damages and half punitive damages.

Notwithstanding the case's legal significance, Ellison, speaking with uncharacteristic understatement, found his own significance to the outcome: "This

Harlan Ellison outside courtroom: "Stop that man! He's the one who tried to assassinate . . ."

is a landmark decision in support of the integrity of the primacy of interest of a writer in his material. The invidious and meretricious practice of outright theft in the film industry has been struck a heroic blow. The clear message here is for writers who care about their work to fight."

[The preceding report was filed by our correspondent Stephen Robinett, at the trial in Los Angeles.]

Poor **Edward Teller**. Everyone seems out to get him. In his famous "I was the only victim of Three Mile Island" advertisement of a year ago, the nuclear physicist and father of the H-bomb told how he was done in by an actress. Dr. Teller explained that on May 7, 1979, a few weeks after the Three Mile Island accident, he was in Washington, D.C., to "refute some of the propaganda that Ralph Nader, Jane Fonda, and their kind are spewing to the news media in their attempt to frighten people away from nuclear power." Teller, seventy-one years old at the time, said he was working 20 hours a day and the strain was too much for him. The following day he suffered a heart attack. "You might say," Teller wrote in a full-page ad in the *Wall Street Journal*, "that I was the only one whose health was affected by that reactor near Harrisburg. No, that would be wrong. It was not the reactor. It was Jane Fonda."

Ms. Fonda, as far as we know, was never apprehended, or charged, for committing this crime.

Then, last February, while Teller was giving a speech at UCLA, a man with the unlikely name of Jerry Rubin—no relation to the radical leader of the late Sixties—hit the scientist in the face with a cream pie. While Teller was not injured, this time he had his revenge. Rubin was immediately arrested and later convicted of battery. He faces a possible six-month jail sentence and a $500 fine.

Michael R. Liebowitz, of the New York State Psychiatric Institute, has been deluged with phone calls ever since the *New York Times* reported that he has found a chemical connection between chocolate and love. Liebowitz likened the giddy response of being in love to "an amphetamine high." He says the crash that follows breakup "is much like amphetamine withdrawal." When in love, according to Liebowitz, your brain produces an amphetaminelike chemical called phenylethylamine. And when studying a group of women he called "love junkies"—people who habitually get involved in hopeless love affairs—he found that many binged on chocolate when these affairs went sour. And what chemical does chocolate have plenty of? Phenylethylamine.

Since the story broke, Liebowitz's phone hasn't stopped ringing. Reporters from all kinds of publications, from *Newsweek* to the *National Enquirer*, want to interview him. Publishers want him to write books. Love patients want his help. Publishers and patients. Even here there may be a connection. Liebowitz described his love junkies as being typically bright and physically attractive. And an inordinate number of these women, he says, work in the publishing industry.

What does he do for them? Since these patients do not respond to antidepressant drugs, Liebowitz treats them with psychotherapy and a class of drugs called monoamine oxidase inhibitors, which inhibit the breakdown of phenylethylamine. These drugs have one rather serious drawback, however, as a love medication: They prevent some women from attaining orgasm.

After attending the annual Norwescon science-fiction convention in Seattle, Washington, recently, writer **Theodore Sturgeon** dropped down to Olympia, the state capital, to give a talk at the local library. He took a few minutes to chat with *Omni* beforehand about change, movies, religion, the future, and Sturgeon's Law.

Omni: Is science fiction changing?

Sturgeon: It's changed a lot, and still is. It's moving away from the nuts-and-bolts types of stories, from outer space to inner space. Science fiction is people, and their motivations are important. That's what makes good fiction.

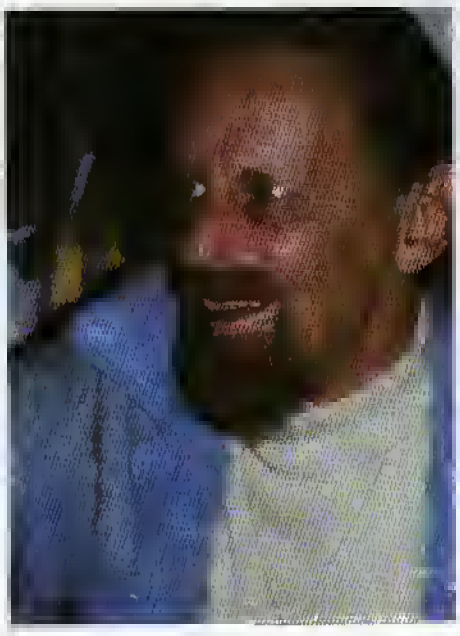
Omni: And what about people like Jerry Pournelle and Larry Niven? They've written fine hard-science fiction, and still do, separately and together.

Sturgeon: Oh, sure. They're very good. No doubt about it. I certainly have no arguments with them, or they with me—except perhaps over my politics.

Omni: How so?

Sturgeon: Well, you know Jerry's been described as being somewhat to the right of Genghis Khan.

Omni: Do you have any favorites among the recent spate of SF movies?



Theodore Sturgeon: Tells how his law was born.

Sturgeon: Well, *Star Trek* for one. That was so nostalgic for me. I wrote two of the TV episodes ["Shore Leave" and "Amok Time"]. So it was a nostalgic trip for me. The movie as it was finally made wasn't quite the way Gene [Roddenberry] wanted it to be originally. He had to make compromises. If it had been exactly like the TV series, only the Trekkies would have understood it, and if it had been completely different, there would have been no continuity at all.

Omni: What about *Star Wars*?

Sturgeon: Loved it. It was completely consistent—*completely* consistent.

Omni: And *Close Encounters*?

Sturgeon: Dumb. Dumb and downright stupid. It had inconsistencies all through it. *The Black Hole* was completely awful.

Omni: Have you done any movie scripts?

Sturgeon: I've been approached many times, but I haven't done much. I really want to stay out of that Hollywood scene.

Omni: Getting back to the real world, what current trends will cause major changes for us in the future?

Sturgeon: Two things, mainly. The first is microelectronics, which is changing the face of the world. It will cause the death of freeways, for example. People will be able to stay at home and do their work, their research, their schooling—everything—through computer terminals. They won't have to go anywhere anymore. The other thing is that I think we will see less ritual, but more religion. The pendulum is swinging, you see. And this is pretty serious for the churches. But I think we're seeing that beginning to happen already.

Omni: And over all?

Sturgeon: Over all, things will get worse before they get better. We may find ourselves marching in step, wearing the same clothes, maybe for a thousand years or so. But that will end.

Omni: You are forever connected with Sturgeon's Law—that "ninety percent of everything is crap." How did you come up with that? Was there a particular moment when you actually thought it up?

Sturgeon: [laughing] Oh, yes! I was at an SF convention sometime in the 1950s, and I was scheduled to be on a panel with some other people to talk about SF literature and so forth. And this one guy on the panel—I really don't remember who it was—he was going around collecting books, and he took them up to his room and spent the entire night going through them. The next morning the panel convened, and here he comes with all these books, and little slips of paper stuck all through them. Well, he proceeded to take about half an hour to read the passages he'd marked. And they were the most God-awful things you've ever heard. Terrible! Just terrible! People were rolling on the floor. And when he finished, he turned to me and said, "Mr. Sturgeon, ninety percent of all this SF is crap." And I just looked at him and replied, "Well, ninety percent of *everything* is crap." Little did I know that it would become a law.

What got me to write this ANAGRAM?
Something A MAG RAN

COMPETITION

By Scot Morris

Our eleventh Competition, announced in January, asked for anagrams. Readers made it look easy, readily outdoing our first attempts. What impressed us most was how, from a single starting point, they found such diverse rearrangements. Consider the messages that competitors found in the letters of **Three Mile Island**: Learn mid the lies (*Charles R. Jamison, Elyria, Ohio; Doug Anderson, Dayton, Ohio*), It is renamed Hell (*Lars Beck, Loveland, Ohio*), I'm in lead shelter (*Bruce A. Martin, Northville, Mich.*), Learn! Heed limits! (*Dee Olson, Park Ridge, Ill.*), Steam ride in Hell (*Stephen Dudzik, Maplewood, N.J.*), Lies hid near-melt (*Dick Jacobs, Chicago, Ill.*), and All die in the REMs (*Kevin Westerlund, San Rafael, Calif.*).

Repetitions were inevitable. The most common were these: **Outer Space**—Peace tours, Escape tour; **Solar Energy**—Years longer; **Margaret Thatcher**—That great charmer; **Astronomer**—Moon starer; and **Halley's Comet**—Shall come yet. From nearly a hundred tries at **Albert Einstein**, the best repeats included: Ten elite brains; Bent lines are it!; and Best in relatin' E. John D. Roth, of Minneapolis, had this to say about the **Ayatollah Khomeini**: Ak! I hate the holy oil man! Others, dropping the definite article, transposed **Ayatollah Khomeini** to: I make hay on oil halt; and Hail, hail to a monkey.

A few anagrams looked so good that we suspect they were not original: From **Madam Curie**—Came radium; **Elias Howe** (inventor of the sewing machine)—I sew a hole; **Voltaire**—I love art; and **Ernest Rutherford**—Renderer of truths.

Also, as we have come to expect, many readers tried to butter up the judge. The **Anagram** anagram at the top of this page came from Arthur Lander, of San Francisco. Others: **Omni Magazine** became O, amazing mine, and Gaze in, mon ami! **Games in Omni** was transposed to I'm goin' Mensa. **Games by Scot Morris** became My score's most, I brag. Several found the magazine preference of **Leonard Nimoy**—Read only *Omni*.

All in all, a surprisingly good assortment. Congratulations to all.

GRAND PRIZE WINNER ($100)

U.S. Space Shuttle Program—Support us: Telegram cash!
—*Brad V. Brase, Fresno, Calif.*

RUNNERS-UP ($25)

Arno Penzias and Robert Wilson (Nobel Prize winners)—Arn and Rob win neat Oslo prizes.
—*Ron Nielsen, Stevensville, Mich.*

Tenor Luciano Pavarotti—Top vocal Titan in our era.
—*Rocco Mattera, Brooklyn, N.Y.*

New Year's Resolution—Only we aren't serious.
—*Jim Hanson, Broomfield, Colo.*

Slot Machines—Cash lost in 'em.
—*Richard Skelenar, East Hartford, Conn.*

Dmitri I. Mendeleev—I'm element divider.
—*Lynne Rittmanic, San Francisco, Calif.*

Many a Sad Heart Can Whisper My Prayer—A Merry Christmas and a Happy New Year.
—*Robert T. Wainwright, New Rochelle, N.Y.*

Widespread Livestock Mutilations—"Visited animal, slew, took tripe, cuds."
—*E. M. Gonzales, Eagle Pass, Tex.*

IM NO anagrammist, but IM ON to a pretty good one I thought up ON MI own.
Isaac Asimov—*Asi vaciamos*, Spanish for "Thus we become empty."

I NO MI anagram is not a description of Mr. Asimov's works, but it is the best I could do for the MONI.
—*John D. Boatright, Oxnard, Calif.*

Prime Minister Pierre Elliott Trudeau—I'm retired at rule until time is propére.
—*Barb McGeein, London, Ont., Canada*

HONORABLE MENTION

One Small Step for a Man, One Giant Leap for Mankind—NASA P.A.: "All is fine. Men and LM OK. Prefer moon to Tang."
—*Robert G. Westmoreland, Ozark, Ala.*

Watson and Crick—Cracks DNA to win.
—*Thomas D. Ingolia, San Francisco, Calif.; and Shari Lydy, Mt. Zion, Ill.*

Clint Eastwood—Old West action.
—*George Landis, Visalia, Calif.*

Space Age Man Notion—Peace among nations.
—*Doreen Michael, Langley, B.C., Canada*

Western Union—No unsent wire.
—*Rochelle Vickey, Vista, Calif.*

The National Aeronautics and Space Administration—Main actions: to dash on and initiate lunar/star peace.
—*Dave Schindler, Baltimore, Md.*

Stephen Sondheim—He opens the minds!
—*Jon Rider, Santa Monica, Calif.*

Star Trek the Motion Picture—Rocket ship team return to it.
—*D. Clementz, Flint, Mich.*

Statue of Liberty—Built to stay free.
—*Mark Howard, Los Angeles, Calif.*

Robert W. Bunsen—Best burner now.
—*Herb Martinson, Wheaton, Md.*

E. von Däniken UFO Theory—O, invent one hokey fraud.
—*Jimmy Reynolds, Lubbock, Tex.*

Chariots of the Gods?—It's good for the cash.
—*J. Shea, Bordentown, N.J.*

Piet Mondrian—I paint modern.
—*F. J. Healy, Port Coquitlam, B.C., Canada*

Mother Theresa—Rest at her home.
—*Jack Liskin, Venice, Calif.*

Star Trek the Movie—Is the TV rot remake.
—*Walter Ross, Charlottesville, Va.*

Einstein's General Theory of Relativity—

Great lone traveler to infinity? Yes, he is!
—Grant Stroup, Bend, Ore.

Gulf Oil Company—O, go fill up my can.
—Tim Rasmussen, Boise, Idaho

Nuclear Radiation—I race to ruin a land.
—David S. Cohen, Upper Montclair, N.J.

Income Tax—No exit, Mac.
—Arthur Lander, San Francisco, Calif.

Los Angeles, California—So, refill a gasoline can.
—R. Kemalyan, North Hollywood, Calif.

Stone Age—Stage one.
—Michael Jordahl, Aurora, Minn.

Ronald Reagan—An old-ager ran.
—Don Wells, Houston, Tex.; and Ken Grier, Tampa, Fla.

Marcello Mastroianni—I'll star on Roma cinema.
—Judith Klein, East Brunswick, N.J.

Richard Nixon—Nix on Richard.
—Peter Esposito, Rochester, N.Y.

Television Set—I've one. Let's sit.
—Charles Wells, Houston, Tex.

Sir Isaac Newton—I wasn't a "Sir," once.
—John F. Hill, Knoxville, Tenn.

Henry Cavendish—Canny HH deviser.
—Henry D. Schreiber, Lexington, Va.

Radioactive Wastes—Avoid tears, acl wise!
—Julie Cohen, Upper Montclair, N.J.

That's One Small Step for a Man—NASA tramples the moon flats.
—Lars Beck, Loveland, Ohio

Neil A.—Alien.
—Serge Botsaris, Wayland, Mass.

Watergate—We get a rat.
—Lauren H. Smith II, Philadelphia, Pa.

Tennessee Williams—I sell sweet sin, Amen.
—Dorothy Smith, Miami, Fla.

Mona Lisa—A man's oil.
—Paula Bochicchio, Scranton, Pa.

Alexander Graham Bell—Ma Bell rang, Alex heard.
—Peter Stratis, Scarborough, Ont., Canada

Steve Martin—I'm near TV set.
—Brian Kosloske, East Berne, N.Y.

Hypochondriac's Useful Ailment—"No cures, Doc—my health is painful."
—Desiree Webster, Warrensburg, Mo.

Dr. Isaac Asimov—I avoid sarcasm.
—John F. Hill, Knoxville, Tenn.

Anwar Sadat—At a sand war.
—Paula Grossman, Hagersten, Sweden

Moshe Dayan—He's a dynamo.
—Phil Meyer, Vermillion, S.D.

Homo Sapiens—So's man, I hope.
—Mark S. Milker, Honolulu, Hawaii

Elvis—Lives.
—Kyler Laird, Rensselaer, Ind.

OPEC—Cope!
—Nick Bozovsky, Cicero, Ill.

Make Peace Not War—Two keep man a race.
—Barry Walden, Whonnock, B.C., Canada

Science Fiction—I fit conscience.
—Jack Liskin, Venice, Calif.

Freudians—Ids are fun.
—Chris Hyman, Manchester, Mo.

Harlan Ellison—I? A snarl? Hell, no!
—Karen Williams, Pocatello, Idaho

Omni Magazine's Games—Some amazing enigmas
—April Gannuscio, Ridgefield, Conn. ∞

AQUATIC WONDERLANDS

EXPLORATIONS

By Kathleen Stein

Coral reefs are the oldest ecosystems on Earth. Their imprint etched the mud and sand 700 million years ago. By the beginning of the Devonian Period—when Europe and Africa were still approaching each other—the coral structures of the world's seas were much the same as they are now.

Yet coral reefs are as delicate and vulnerable to human intrusion as anything else on Earth. Now, at the tag end of the twentieth century, divers who visit the great reefs face the recurring paradox of our time: How can we truly know something when the act of observing alters the thing being observed?

Some say that a well-dived reef site is already on its way to extinction. However, that rule is being changed, in some areas at least. These most venerable of animal colonies are being protected through a growing number of new underwater parks and preserves.

On U.S. Highway 1, running through Key Largo, the first and largest of the Florida keys, an unobtrusive sign announces the entrance to John Pennekamp Coral Reef State Park. Visitors to the park find a modest terrain: 2,290 acres of upland that includes 60 campsites, bathhouses, boat docks, and a swimming area. What is not immediately apparent is the rest of the park: 178 square nautical miles of mangrove swamps, grass beds, blue-green seas, and reefs. Pennekamp is the world's first underwater park, a sanctuary for marine life and a fantastic sea garden where land life can explore the ecosystem beneath the waves.

Underwater (u/w) parks are the latest in natural recreation areas. Besides Pennekamp, which opened in 1962, there are now at least seven other u/w parks in the United States and Canada and two National Marine Sanctuaries (one bordering on Pennekamp, the other off Cape Hatteras, North Carolina). Many more sites may soon be designated as preserves or controlled diving areas.

The invention of scuba apparatus helped pave the way for u/w parks. Scuba provided a radical new perception of the sea and its inhabitants. The discovery parallels the late-nineteenth-century recognition that Yellowstone, Yosemite, and other unique natural sites have a special beauty that is all too fragile. Many such areas now are both protected from people and open to them. Underwater parks are an extension of this interest in preserving natural wonderlands.

Coral reefs: entire housing projects and welfare systems for a plethora of marine life.

Pennekamp is a case in point. In 1957, at a biological conference on natural resources in south Florida, Dr. Gilbert Voss, of the Marine Institute of the University of Miami, described the damage occurring on the outer reefs and the depletion of marine life there. Since the Thirties, the sea-life novelty trade had been booming. Great mounds of queen conchs had become trademarks of the "tourist trap." (They have since been exhausted in the keys.) And with the shells, coral was offered. The supply of the graceful white branches could never satisfy the demand. Collectors descended on the reef in everything from dinghies to barges and, with the aid of crowbars and hoists, began to rip the reefs apart. Commercial shell operations turned them upside down for rare specimens. Early scuba divers prowled the area with spear guns ready to pick off everything that swam through the pellucid waters.

In 1959 control of the ocean floor to the three-mile limit was signed over to the Florida Board of Parks and Historic Monuments; the area beyond went to the National Marine Sanctuaries in 1960. The new preserve was named in honor of *Miami Herald* editor John Pennekamp, a longtime champion of conservation. Efforts to protect these waters have paid off. Today Pennekamp is home to more than 50 species of coral and 560 species of aquatic life.

The Caribbean Sea is an ideal location for u/w parks, and there are two in the U.S. Virgin Islands: a snorkeler's trail at Buck Island, off St. Croix, and another at Trunk Bay, St. John. Both sites are overused, but many less-dived acres of park waters around St. John are also managed by the U.S. National Park Service, and they support a diverse and fascinating complex of coral reefs. While visiting the island, stay at the "ecologically sound"

Maho Bay Camps and explore the myriad lagoons and bays that support the reefs fringing the island.

For scuba divers, the wreck of the Royal Mail Steamer *Rhone* (portions of the movie *The Deep* were filmed around this wreck) provides a ghostly 80-foot dive. RMS *Rhone* sank in a hurricane off Tortola, British Virgin Islands, in 1867, and in the ensuing century it has undergone a sea change into something rich and strange. The *Rhone*, a diver's treasure-trove, now supports abundant fish life and a spectrum of colored coral and sponge—all of which are protected by the Islands government. Glide in between the 20-foot columns that, like the ribs of a dead mythic beast, are the sole remains of the ship's superstructure. Or tunnel through the hull into the bulkheads and cabins, and imagine that the glittering morphine vials of *The Deep* are waiting for you.

For the best coral display, though, try Pennekamp's morning snorkel trip to Grecian Rocks. It was stormy the day I went out, and the visibility was 50 feet, murky by local standards. But for me it was an alternate universe. Spread out in aquavision were huge stands of elkhorn, pillar, brain, and savage fire coral. Animals bloomed like plants, and plants seemed to crawl around like animals.

A word of warning: Reef fever is endemic to reef diving. Before long you will develop an insatiable curiosity; you'll need to know everything about coral.

The secret life of the polyp: Coral reefs are entire housing projects and welfare systems for marine life. Their "bureaucracies" support a larger number of plant and animal species than any other. In fringing reefs such as St. John's or a barrier reef such as Pennekamp's may live filamentous algae, corals, fans, sponges, sea anemones, truncales, mollusks, crustaceans, and a plethora of fish. All the tropical breeds abound. Butterfly, angel, trigger, and parrotfish, wrasse, grouper, and barracuda—all find shelter, food, and oxygen in the reefs' mazes.

Reefs are sand factories. Fish munching on coral generate an estimated 2.5 tons of sand per acre every year, creating a healthy environment for the thousands of species that cannot live without a sandy seabed and humans who crave white beaches on which to sauté themselves.

The adult coral is a simple, sessile (not free to move about) filter feeder whose tubular body is attached to a seabed, a rock, or another coral. A single coral polyp, never larger than a pinhead, consists of nothing but a mouth and a digestive tract.

A fish fishes, and so does coral. At sunset corals extrude from their stony cups tiny arms that wave drifting plankton and microscopic crustaceans into their mouths. Corals also poison. The tentacles of many polyps are equipped with complicated trapping and shooting devices. These special stinging cells, called nematocysts, expel tightly wound missiles that penetrate the prey's body and paralyze it with toxins.

A coral's body has only one opening. The closed end forms the base of the polyp. Each individual polyp secretes lime (calcium carbonite), which builds up story after story of cup-shaped exoskeleton. Over millennia the minutiae grow into coral cities hundreds of kilometers long.

Corals pump out an amazing ten grams of lime per square meter of polyp surface a day. This requires tremendous amounts of energy: The polyp's metabolic rate is almost three times that of a human at rest. For this activity, corals need continuously moving water that is well lit and rich in oxygen and nutrients.

Polyp love: Coral can propagate asexually by cell division and sexually by fusion of male and female germ lines. A few corals are hermaphroditic. Eggs may be fertilized within or without the body, and after hatching, the larvae are transported over long distances by waves and currents. Once they find a suitable support—usually another reef or a wreck—they affix themselves and metamorphose into polyps. A living reef is basically a veneer growing a few millimeters per year atop a complex topography of superimposed skeletons—the deserted shells left behind by generations of tiny master builders.

> *"Spread out in aquavision were huge stands of elkhorn, pillar, brain, and savage fire coral. Animals bloomed like plants, and plants seemed to crawl around like animals."*

Reefs form rigid palisades, self-repairing breakwaters that shelter land against storms. The coral's porous structure and massive interweaving of buttresses and channels dissipate wave energy and allow the flow of sediment that would otherwise suffocate it.

The Florida Key reefs, existing precariously at the northernmost edge of their climatic range, are subject to stresses far beyond those that afflict Caribbean reefs. Surviving thousands of years, they have built and shaped the Florida peninsula. If they die, much of the Sunshine State could be swept away.

The worst threat to reefs is human intervention. Divers must learn that breaking off a branch is lethal. Such seemingly insignificant damage as abrasion invites invasion by deadly forms of algae. Some infections spread at incredible rates, stripping the coral's tissue until only a white skeleton remains. If the water is polluted or if its light is obscured, the coral dies.

The inhabitants of the reef are as interdependent as the citizens of a city. When coral dies, marine life must migrate or starve. Dead coral structures, like abandoned buildings, decay into rubble, infested by parasites and algae.

There should be a sign above the entrances to all u/w parks: FLIP LIGHTLY, ALL YE WHO DIVE HERE. When exploring submarine wildernesses, observe simple precautions. Don't spearfish. Don't souvenir-hunt. Learn the basic ecology of the area. Practice diving skills; a good diver won't kick up sand or need to stand on coral. Dive with experienced divers, and select trips to reefs that have had a chance to recover from the last visitors. Don't wear suntan lotions. Act responsibly; the reef may be the most fragile ecosystem on Earth as well as the most beautiful.

IN TRANSIT

Pennekamp Coral Reef State Park, Key Largo, Florida. Open all year. Visibility 10 to 100 feet.

Buck Island U/W Park, St. Croix, U.S. Virgin Islands. Features a snorkelers' trail. Visibility 100 feet plus.

Edmunds U/W Park, on Puget Sound, Edmunds, Washington. A sunken drydock and wrecked tugboat have become the seedbed for a rich variety of marine life. Visibility 5 to 100 feet.

Point Lobos State Reserve, Carmel, California. An ecological preserve, Point Lobos has been called "the greatest meeting of land and water on Earth." Owing to its popularity, however, ten buddy teams are allowed to dive at one time. Get there early. Visibility 30 to 60 feet.

San Diego–La Jolla U/W Park, La Jolla, California. Also very popular, it features a rocky bottom with sandstone ledges and abundant sea life. Thirty yards out is La Jolla Submarine Canyon, which should be reserved for experienced divers. Visibility 15 to 60 feet.

Catalina U/W Park, Casino Point, Santa Catalina Island, California. A protected area, monitoring kelp and abalone growth. Visibility 40 to 60 feet.

Five Fathom Park, near Georgian Bay, Ontario, Canada. A mecca for wreck divers. Fierce storms have claimed numerous vessels there. Visibility 10 to 60 feet.

RMS Rhone, Salt Cay, British Virgin Islands. Visibility 100 feet plus.

There are at least two other underwater parks in the works: Julia Pfeiffer-Burns State Park at Monterey California, and Palos Verdes near Los Angeles. And the United States has designated two other Marine Sanctuaries: the one at Pennekamp, and The Monitor Marine Sanctuary off Cape Hatteras, the location of the wreck of the Civil War ironclad. Its remains were discovered in 1973, and regulations concerning this site are stringent since scientists have just begun research ∞

SOLAR MAX

STARS

By Mark R. Chartrand III

"The sun," Chicago astronomer E. N. Parker declared, "is an obstinate reminder that while we may possess all the basic differential equations of classical and quantum physics, the rich variety of solutions to those equations extends far beyond present knowledge and imagination." Last February a Thor 3910 rocket roared skyward from Cape Canaveral, carrying a 2,100-kilogram satellite whose purpose is to determine just which of those solutions are correct.

Called the Solar Maximum Mission (SMM), this remarkable spacecraft is the vanguard of a new species of modular, retrievable satellite, repairable in orbit, with new communications links to Earth. Actually costing less than its original budget—about 36 cents for each U.S. citizen, spread over several years—the satellite heralds a new understanding of Star Number One.

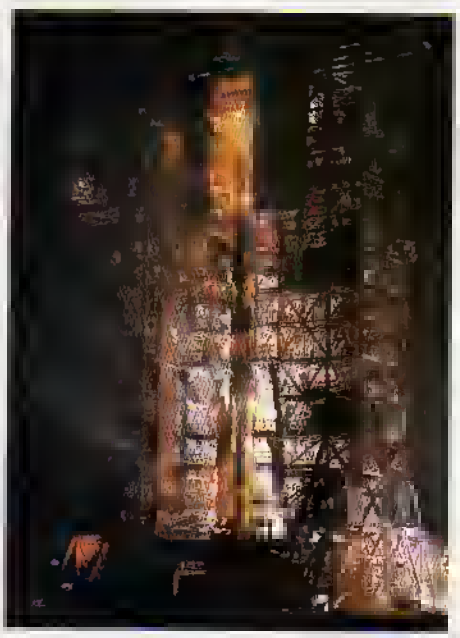
The SMM is designed with two main purposes: to study the three-dimensional details of the violent events called solar flares and to measure with extreme accuracy the total energy output of the star we depend on for our lives.

In the past few years some astronomers have begun to have questions about the sun, which was long thought to be a relatively simple fusion reactor and extremely stable. Studies of solar neutrinos have found far fewer particles than the sun should emit; does this mean its fusion fires have gone out? The sun is shrinking; could its heat be derived from gravitational energy? Now a few scientists have begun to suspect that the sun is slightly variable in energy output. Even a 0.2 percent change would have great consequences for us on Earth. The SMM will be able to measure the sun's energy to an accuracy of 0.1 percent.

For reasons still unknown, the sun has a magnetic field that occasionally bunches up in knots where the magnetic field lines protrude through the surface. This produces areas where the temperature is only about 4,000° C, cooler than the usual surface temperature of 6,000° C. These cooler areas are only about a third as bright as the surrounding surface, and so they appear dark, almost black, by contrast. These dark areas are called sunspots. Some of the sunspots are considerably larger than the earth.

Every eleventh year, roughly, the number of spots on the sun reaches a peak, along with other solar phenomena. The level of activity varies from peak to peak. The most active period ever known came in 1957 and 1958, just at the beginning of the Space Age and before any solar-observing satellites were available. Up to that time, the only way to examine the sun free from the interfering atmosphere was with rocket probes, which could observe for only a few minutes at the top of the flight. The first solar telescope went into orbit in 1962. The next solar peak did not occur until 1968 and 1969—and a fairly minor peak it was.

This year is another peak period, and judging from the buildup it looks as if we will see the second-greatest level of activity since the existence of sunspots was discovered. And this time the astronomers are going to be prepared.



Solar Max *will send its data by relay satellite.*

Near the sunspots are areas of increased activity, including solar flares. Flares, about 8,000 kilometers above the surface, are regions that suddenly burst forth with enormous amounts of radiation and high-energy particles. A single flare can release the energy of 10 trillion hydrogen bombs, raising temperatures to tens of millions of degrees—hotter than the center of the sun itself. All this happens in only a few minutes.

The instruments aboard the SMM will monitor regions of the sun where flares are expected. Fifteen times a day the data will be radioed to the flight operations office at the Goddard Space Flight Center, in suburban Maryland. Within hours most of the information will be available to mission controllers. Terrestrial observatories will also coordinate some of their observing time with the spacecraft.

During the year-long program—it is likely to be extended—this coordinated assault on the secrets of solar activity will reveal where in the sun's atmosphere the flares begin, how they propagate, and which—if any—of our models of the sun's magnetic activity are correct.

The SMM itself is the first satellite designed to use the multimission bus, a kind of stock basic unit that can supply power, attitude control, data handling, and communications for many types of space missions. It is designed to be repaired in orbit if necessary.

The SMM is also designed to be retrieved from orbit and brought back to Earth. This is the first fulfillment of the space shuttle's promise. Barring further slips in the shuttle's schedule, the SMM is due to be caught and returned in December 1982—by the second flight of Shuttle 099, dubbed *Challenger*.

At a planning meeting for the mission reported in the journal *Physics Today*, Dr. Parker evidently saw our attempts to understand the universe as a sort of divine comedy: "The sun, then," he said, "is our Vergil, acting as guide through level after level . . . as we look more closely into the inferno."

But he's not abandoning all hope of an eventual solution.∞

GAMES

ANSWERS TO GAMES (PAGE 128)

QUIZ 1: HOMONYMS

1-e, moon
2-c, fair
3-f, Phoebe
4-i, points
5-h, culture
6-b, Mars
7-j, drop
8-a, Bell
9-g, crank
10-d, dust

BUBBLE MACHINE

QUIZ 2: HOMOPHONES

1-e, time/thyme
2-c, plane/plain
3-d, brake/break
4-g, hole/whole
5-h, skull/scull

STEEL MAZE

6-a, spits/Spitz
7-b, sun/son
8-i, check/Czech
9-j, throe/throw
10-f, knit/nit

QUIZ 3: HOMOGRAPHS

1-h, lead
2-d, contlict
3-i, wound
4-e, defect
5-a, incense
6-f, real
7-j, invalid
8-b, coop
9-c, intimate
10-g, conduct

QUIZ 4: ANAGRAMS

1-b, Poles/slope
2-g, thermo/mother
3-h, Nepal/plane
4-e, lapse/pales
5-i, Lunar/ulnar
6-j, General/enlarge
7-f, space/paces
8-a, clam/calm
9-c, priest/stripe
10-d, ether/there

PINBALL

ACKNOWLEDGMENT

Appreciation is due to several people for help in setting the record straight about Dr. Charles Drew (Games, page 128). I am indebted to Eric Lipes, science teacher at Charles Drew Intermediate School, in New York City, for first calling the error to my attention; to Anna Dembner, of Red Dembner Enterprises, New York, for pointing out parallels with the story of Bessie Smith's death; and to Warren Jackson, of Gannett Westchester Newspapers, and Dr. Raymond Polin, of St. John's University, in New York, for helping to put me in touch with Dr. John R. Ford. Thanks. ∞

EARTH

CONTINUED FROM PAGE 18

asking the function of hemoglobin or insulin in our blood. Questions about the function of parts and components are proper when we deal with operating cybernetic systems, such as life.

Why is there 21 percent oxygen in the air? If there were 25 percent, the probability of fires would be so great that all standing vegetation would be consumed in a series of vast conflagrations inevitably ignited by lightning. Like all chemically reactive gases, oxygen appears to exist in the right proportions for the continuation of life.

Most of the evidence for Gaia is of this kind, circumstantial at best. Its existence cannot be proved, but we can still consider the consequences of its presence.

From a Gaian point of view, humankind's most disturbing act is the destruction of natural habitats, which house the processes that regulate Earth's climate and chemistry. The most likely sites for these control systems are the muds of the continental shelves, estuaries, wetlands, and perhaps the tropical forest ecosystems.

If we are all—from the lowliest microorganism to the largest whale—a part of Gaia, then we are all potentially important to its well-being. Therefore, the ecologists who deplore the elimination of a species are not merely appealing to our sentiment. They are warning us, often without knowing it, about a blind and dangerous tinkering with the mechanism of the world. It is not enough just to regret the extinction of a whale, or even of the smallpox virus. When we delete one of these from Gaia's catalog, we may have destroyed part of ourselves. We are also a part of Gaia.

Perhaps now we can understand why the sight of a natural landscape brings us such pleasure: It is our reward for leaving the earth undisturbed. Conversely, the pain we feel at the sight of human suffering or an urban ghetto is Gaia's punishment for our letting the environment degrade.

We may have evolved together with Gaia, interacting and regulating our environment. It may also be that we, as a species, have a role in the global network of information exchange. If we can use all of our powers to save humankind, we would also be saving Gaia.

The consequences of our presence are mostly a matter of scale. We manipulate entire geographic regions to feed ourselves; what would happen if we farmed the entire planet, thereby destroying the bulk of our regulating systems? In the past we might have thought that we had won the battle over nature, but today the fallacies of that argument are apparent. Gaia would be so stifled by global farming that we would soon discover that Spaceship Earth was not a living planet, but a prison hulk. We would be slaves forever, attempting in vain to regulate and maintain the optimal environment that Gaia so freely provides. ∞

COMMUNICATIONS

CONTINUED FROM PAGE 10

there now, I found it disheartening that a spelling error in the name of the town could have slipped by your researchers. I am not speaking of Punxsutawney (which is not easy to spell; some natives of the town even call it Punxsy), but of Cloe, as it is correctly spelled.

The most shocking part of the article, however, was not the spelling error but the statement, "No one with a grasp of reality, as we know it, would build a road between Punxsutawney and Chloe." Now, I admit that neither Punxsutawney nor Cloe is a growing metropolis, but a road between them is imperative to the mass of journalists who flock to Punxsutawney on February 2 each year. You see, Punxsy is the home of the world-renowned weather-forecasting pair of Phil and Phyllis Groundhog. If it were not for the roads between Punxsutawney, Cloe, Big Run, McGees Mills, and all the other small towns of the area, journalists from New York, Washington, D.C., and other cities could not observe the great event when Phil and Phyllis come out of their den to see their shadows.

Sharon Keller
Fort Collins, Colo.

Best of *Omni*

This is a note of appreciation for your *Best of* Omni *Science Fiction*. It has to be the most enjoyable fiction collection and one of the best I have ever read. The choice of stories was fantastic!

I am a regular fan of *Omni*, and I never miss an issue. Next to the fiction and the Games pages, I *love* your cartoons.

Congratulations that your fame is spreading. May your ideas and printer's ink never dry up!

Barbra Bolt
Gatlinburg, Tenn.

Thank you for both the superb graphics and the fiction contained in the *Best of* Omni *Science Fiction*. Savoring the articles that I have read in *Omni* was well worth twice the price of the issue.

Lawrence D. Grim, Jr.
Ft. Meade, Md.

Graphics

I find your magazine quite fascinating. But what really blew my mind was the cover of your May [1980] issue. That picture is beautiful! I must have stared at it for an hour.

Patti Bruggen
Green Bay, Wis.

I was greatly taken by the art accompanying "Men Like Us" [May 1980]. I liked it for its own sake, but the association was even more impressive. There is no way the artist could have known that the initial scene of the story was suggested by a vignette from Hieronymus Bosch's *Last Judgment*. The art was perhaps a little closer in feeling to the younger Brueghels than to Bosch, but that's six of one, half a dozen of the other. The painting is simply perfect for the story and proves that the artist really understood what he was dealing with, though his interpretation was surreal.

David A. Drake
Chapel Hill, N.C.

I've read the February [1980] issue of *Omni* from stem to stern and have sent off a check today for our own subscription, resolving never to be without the magazine again. One of the most stunning things in the February issue was Fred Durant's piece on Chesley Bonestell and his art, with the beautifully reproduced examples of Bonestell's paintings. I've seen some of these in the original, I think, at the Smithsonian's Air and Space Museum, and I have seen some reproductions elsewhere, but as published in *Omni* they are surely breathtaking.

G. Edward Pendray
Founding Member
American Interplanetary Society
Jamesburg, N.J.

Cosmic Rip-off

Saying that "the sun is a second- or third-generation star" [Space, February 1980] made me think we've been victims of a grand cosmic swindle. They gave us a used solar system!

Juan Aburto
San Jose, Mexico

Inverted

The photograph on page 39 [Continuum, May 1980] of a prebiotic synthesis reactor is inverted.

The eventual creation of life in such a situation will give rise to organisms with their heads and backsides interchanged, and I, for one, see no compelling need for another governmental body. *Populus iamdudum defutatus est.* (I grant William Proxmire a conditional pardon, even if it does make monkeys grit their teeth.)

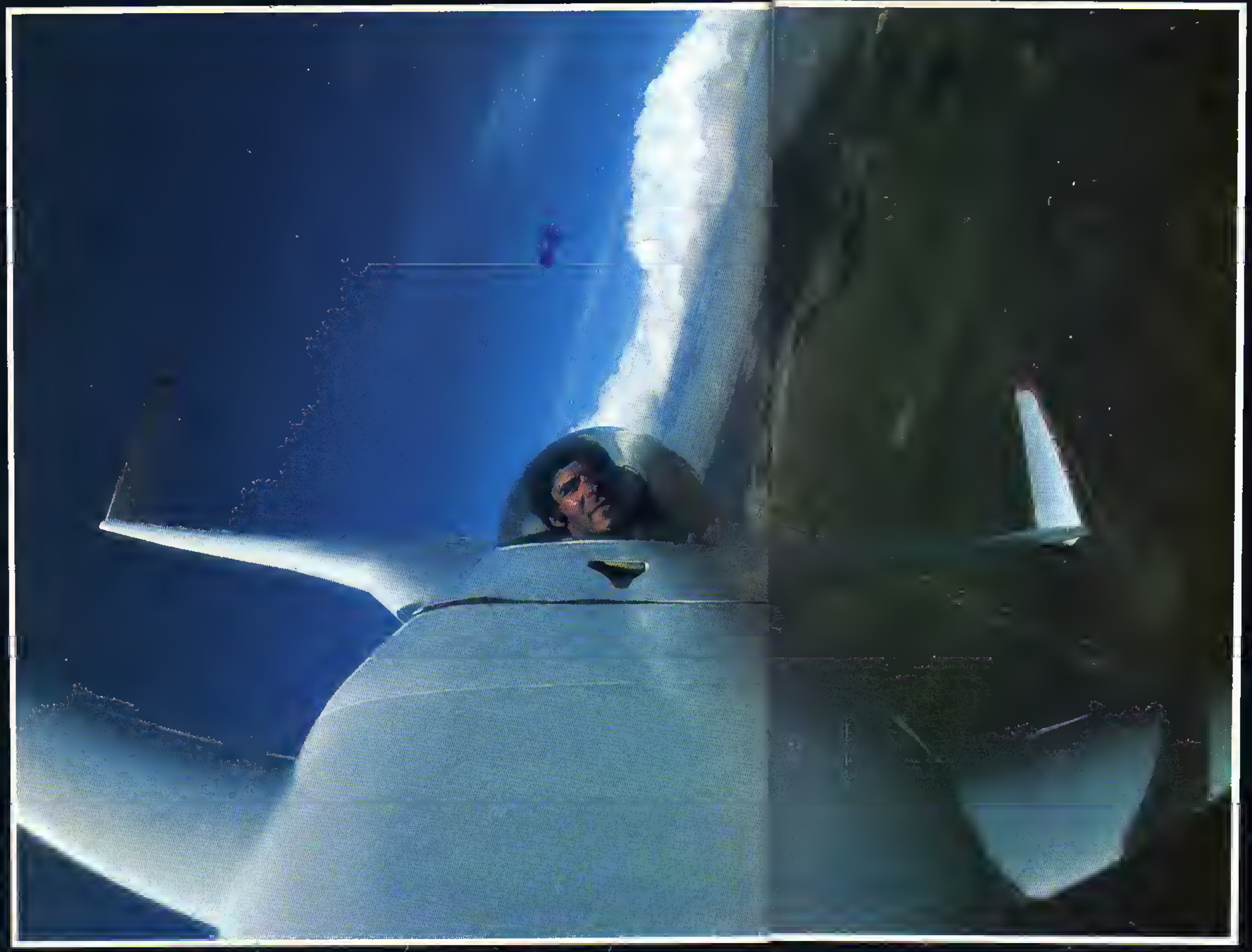
Alan M. Schwartz
Costa Mesa, Calif.

PHOTO CREDITS

Art, **page 88,** courtesy of Somerset Importers, Limited, from a Johnnie Walker Black Scotch advertisement

We apologize for the misspelling of Michael Whelan's name on page 100 of our May issue.

Page 6, Russ Melcher, Marcus Leatherdale, Martha Pearson; **page 18,** Dan Morrill; **page 20,** The Granger Collection; **page 22,** Geoffrey Chandler, **page 24,** Robert Dibué, **page 26,** courtesy Gregg Press; **page 28,** Jay Nadelson, **page 30,** Edward Meier; **page 36 left,** Marc M. Griggs; **page 36 right,** McDonnel; **page 37 left,** Carl Frank/Photo Researchers; **page 37 right,** Flip Schulke/Black Star, **page 38 left,** Saxon Donnelly/University of California, **page 38 right,** NASA; **page 39 left.** Marc M. Griggs; **page 39 right,** Tom McHugh, ©1975/Photo Researchers; **page 40 left,** Mark Helfer/National Bureau of Standards; **page 40 right,** Graphic Arts; **page 41 left,** Allan D. Cruickshank/Photo Researchers; **page 41 right,** Stanford University; **page 42 left,** © Audrey Topping; **pages 44 – 46;** Neil Leifer/Sports Illustrated; **page 47,** Dan McCoy; **pages 54 – 55,** Designed by Shirl Sleeve Studio for Manfred Mann's Earth Band, Bronze Record, **page 117,** Sebastian Bastel; **page 118,** Joel Davis; **page 121,** Al Grotel; **page 123,** U.S.: NASA; **page 130,** Grant Photography.



PHENOMENA

The world drops away beneath him, a canopy of silence all around, as Dick Rutan glides high above the Mojave Desert, banking and soaring like a high-flying eagle. Bone and sinew give way to fiberglass and foam in the Long-EZ, a visionary design from brother Burt Rutan that may revolutionize light aircraft. Able to climb 2,000 feet a minute and travel at speeds upward of 200 miles per hour, the Long-EZ is so nimble that a pilot can execute a 360-degree roll during *takeoff*. The current holder of the distance record for light aircraft (4,800 miles), the Long-EZ will soon attempt to break two other records: longest straight-line distance, from Alaska to Puerto Rico; and altitude, over 30,000 feet. To obtain this panoramic view, Dan McCoy mounted a motorized Contax camera on the fuselage of the Long-EZ. Controlled by a remote switch from the back of the pilot's seat (not visible here), a 16mm Zeiss lens and Kodachrome 64 film completed the picture. Find out what makes Burt Rutan fly in Anthony Wolff's profile on page 100. OO

Mazes, match-'em-ups, and the truth about Dr. Drew

GAMES

By Scot Morris

Adding some color to our pages this month are the unique drawings of Larry Evans. Evans's mazes are unequaled for their beauty, symmetry, graphic design, and three-dimensional quality. His latest book is *3-D Maze Art*, available from Troubador Press (San Francisco).

READER ORIGINAL

The following set of quizzes was sent to us by Al B. Perlman, of Forest Hills, New York. In each, match a numbered item in the left column with a lettered item in the right column. What's the basis for matching? That's the puzzle. There are four principles—different, but related—one for each quiz. If you can't figure them out, there's a big hint in the center of the next page.

QUIZ 1

1 ___Armstrong's turf	a. Ameche role
2 ___Farmer's show	b. Disfigures
3 ___Saturn satellite	c. So-so
4 ___Loci	d. Wipe a table
5 ___Organic medium	e. Flash the *tush*
6 ___Viking sits here	f. Fly catcher
7 ___Lozenge	g. Curmudgeon
8 ___Ship's time unit	h. Arts study
9 ___Turn a handle	i. Antler tips
10 ___Intergalactic stuff	j. Cockneys do it to aitches

QUIZ 2

1 ___Fourth dimension	a. Natator Mark
2 ___Two-dimensional	b. Seth, to Eve
3 ___Car stopper	c. Sans beauty
4 ___Black & outasight	d. Take five
5 ___Brain housing	e. Herb
6 ___Expectorates	f. Kind of wit
7 ___Nearest star	g. Entire
8 ___Verify	h. Propel a boat
9 ___Emotional pang	i. Bratislavan
10 ___Grow together	j. To lose deliberately

QUIZ 3

1 ___First paragraph	a. Infuriate
2 ___Antagonism	b. Fowl house
3 ___Injury	c. Close friend
4 ___Desert a cause	d. Collide
5 ___Sweet smoke	e. Broken part
6 ___Authentic	f. ⅛ peso
7 ___Infirm person	g. Wield a baton
8 ___Group-owned	h. Heavy metal
9 ___Suggest, hint	i. Coiled
10 ___Deportment	j. Void

QUIZ 4

1 ___N, S, & John Paul	a. Serene
2 ___Kind of nuclear	b. Incline
3 ___Katmandu land	c. Chevron
4 ___Hiatus	d. Not here
5 ___Kind of module	e. Turns white
6 ___Mills or Motors	f. Activity rates
7 ___Most of cosmos	g. Hubbard
8 ___Bivalve	h. Wright idea
9 ___Clergyman	i. Re: forearm
10 ___Heavens & $C_4H_{10}O$	j. Blow up

THE TRUTH ABOUT DR. DREW

In Games in January we introduced our *Wives' Tale Quiz* with prophetic words: "Who knows where wives' tales start? Whether they are true or not, they are believed, repeated, followed." That quiz included the following item and answer:

"13. ___The man responsible for developing blood banks died when a hospital refused to admit him for a transfusion because he was black.

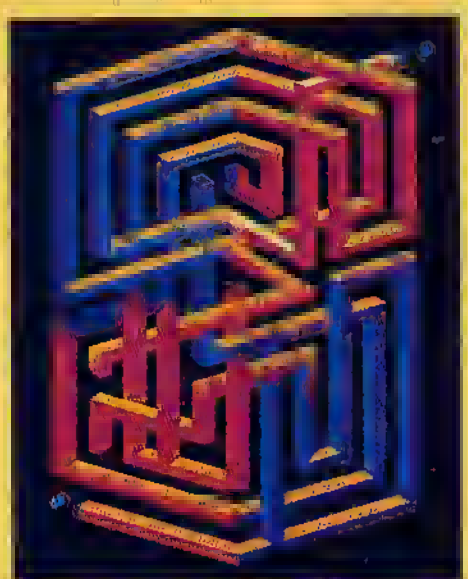
"*Answer: True.* Charles Drew, a pioneer of blood-plasma research and the originator of the idea of a national blood bank, . . . died after an auto accident when a so-called white hospital in Burlington, North Carolina, refused to admit him for a blood transfusion because of the color of his skin. The year was 1950."

Wrong! This story, we have learned, is pure fiction, though it has been told and retold countless times as fact. It is a favorite anecdote of Dick Gregory's, and it appears in William Loren Katz's *Eyewitness: The Negro in American History* (Pitman, 1967), in Phllip T. Drotning's *Black Heroes in Our Nation's History* (Cowles, 1969), and several other black history texts.

"The story is a myth," says Dr. John R. Ford, director of Ford Medical Center, in San Diego. Ford should know. He was in the car crash that took Drew's life 30 years ago. Drew was driving three other black doctors to a conference in Tuskegee, Alabama; Ford was in the backseat, directly behind Drew. "Charlie fell asleep. The car hit a curb, swerved, and rolled over. Drew's neck was broken, and his chest was crushed by the car."

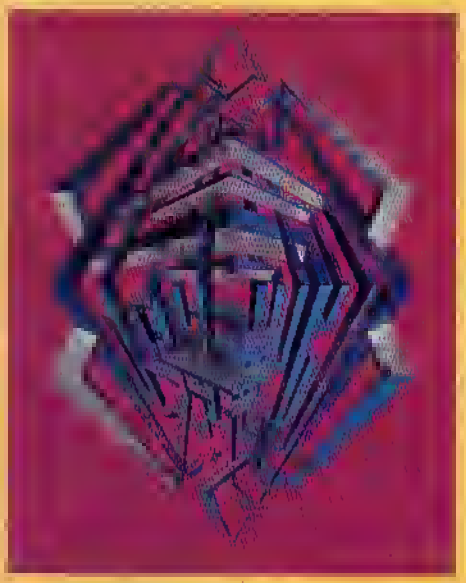
Did Drew get proper medical attention? "We all received the very best of care," Ford told me. "The doctors started treating us immediately on a Saturday morning, during their busy time, with patients lined up for X rays."

Did Drew get a transfusion? "It wasn't indicated. He had a superior vena-caval syndrome—blood was blocked getting back to his heart from his brain and upper extremities. To give him a transfusion would have killed him sooner. Even the most heroic efforts couldn't have saved him. I can truthfully say that no efforts were spared in the treatment of Dr. Drew and, contrary to popular myth, the fact that he was a Negro did not in any way limit the care that was given to him."



BUBBLE MACHINE: Follow the bubbles through the pipes. Don't let any escape.

How did such a myth get started? Ford blames poor reporting by the minority press of the Fifties, but he is being too kind. Someone made the story up, probably for political purposes. The locale



STEEL MAZE: Crawl from arrow to arrow inside the steel tubes. Don't let the reflections fool you.

and the climate of the times made the tale plausible, and people wanted to believe in another horrible example of white people's inhumanity.

Curiously, an almost identical tale surrounds the death of black blues queen Bessie Smith after a Mississippi auto accident in 1937. It is widely believed that she bled to death outside a white hospital that had refused to treat her. Though the whole truth will probably never be known, it is certain she did not die this way. (See *Bessie*, by Chris Albertson, Stein and Day, 1972.) Nevertheless, the familiar account was used by Edward Albee in the plot of his 1960 play *The Death of Bessie Smith* and is popularly accepted as true.

"History," Napoleon reputedly said, "is a fable agreed upon." We hope that in setting this record straight, the fable of Charles Drew's death will finally be put to rest, but we are not optimistic. Journalists won't quickly abandon a widely cross-referenced tale that "should be true" for the sake of a neat moral lesson. For our part, we are pleased to help remove the 30-year stigma that has unjustly followed the doctors at that Burlington, North Carolina, hospital.

BIG HINT

The four match-up quizzes on the opposite page are all based on word relationships. Here are the principles, in alphabetical order, not necessarily in the same sequence as the quizzes.

- *Anagrams*. In one quiz, the words defined have the same letters but in a different order, e.g., *trace* and *cater*.
- *Homographs*. Another set designates words that have identical spellings but different meanings and, often, different pronunciations, e.g., *does* can be female deer or a form of the verb *do*.
- *Homonyms*. These words are the same in sound and spelling but different in meaning. *Lock* can be a device to secure a door, or it can be a tuft of hair.
- *Homophones*. The words in this quiz have identical pronunciations but different spellings, e.g., *mind* and *mined*.

Answers on page 124.

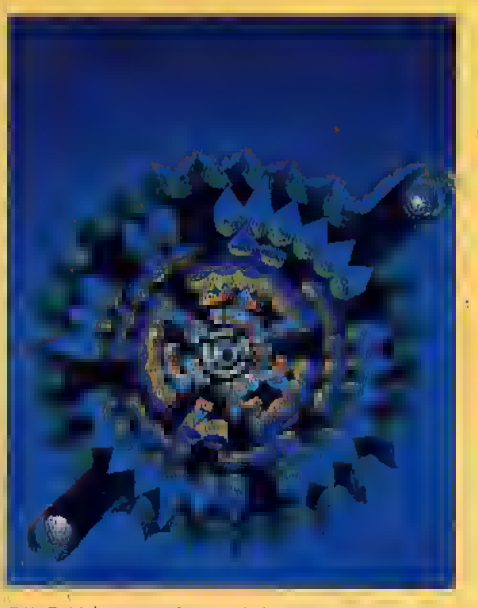
COMPETITION #14: DOUBLE DACTYLS

Higgledy Piggledy
Sir Isaac Asimov
Wrote many volumes of
Erudite stuff:

Black holes to limericks,
Incontrovertibly,
I think that he's written
Still not enough.

If there is any rhyme form as addictive as the limerick, it is the double dactyl. As defined by Anthony Hecht and John Hollander in their book *Jiggery Pokery: A Compendium of Double Dactyls* (Atheneum), the form has these characteristics: (1) an eight-line poem in which the fourth and eighth lines rhyme and each of which has four syllables; (2) all other lines are double dactyls: six syllables with stresses on the first and fourth (DAH-dah-dah-DAH-dah-dah); (3) the first line of the poem must be a double dactylic nonsense line ("Higgledy Piggledy" will always do); (4) the second line must be a double dactylic name (e.g., *Senator Kennedy, Jesus of Nazareth, Ludwig van Beethoven*); (5) finally, somewhere in the poem, preferably in the last stanza, and ideally in the seventh line, there must be at least one double dactylic line that is *only one word* (e.g., *heterosexual, extemporaneous, steatopygia*).

All entries become the property of *Omni*. None will be returned. Entries must be postmarked by August 15, 1980 (September 1 for postmarks outside the United States). The first-prize winner will receive $100. Runners-up (2 through 10) will each receive $25. Send to: Omni Competition #14; 909 Third Avenue, New York, NY 10022.



PINBALL: Walk from pinball to pinball. You are stopped where the blue areas touch.

LAST WORD

By Larry Niven

"The concept of money burning a hole in your pocket would take on new meaning."

It happened around the time of World War I. The director of research for Standard Oil was told, "There's all this goo left over when we refine oil. It's terrible stuff. It ruins the landscape, and covering it with dirt only gets the dirt gooey. Find something to do with it."

So he created the plastics industry.

He turned useless, offensive goo into wealth. He was not the first in history to do so. Consider oil itself: useless, offensive goo, until it was needed to lubricate machinery, and later to fuel it. Consider some of the horrid substances that go into cosmetics: mud, organic goop of all kinds, and stuff that comes out of a sick whale's head. Consider sturgeon caviar: American fishermen are still throwing it away! And the Japanese consider cheese to be what it always started out to be: sour milk.

Now plans for the disposal of expended nuclear fuel involve such strategies as:

- Diluting and burying it.
- Pouring it into old, abandoned oil wells. The Russians tell us that it ought to be safe; after all, the *oil* stayed there for millions of years. We may question their sincerity; the depleted oil wells they use for this purpose are all located in Poland.
- The Pournelle method. The No Nukes types tell us that stretches of American desert have already been rendered useless for thousands of years because thermonuclear bombs were tested there. Let us take them at their word. Cart the nuclear wastes out into a patch of cratered desert. Put several miles of fence around it and signs on the fence: IF YOU CROSS THIS FENCE, YOU WILL DIE.

Granted, there will be people willing to cross the fence. Think of it as evolution in action. Average human intelligence goes up by a fraction of a percent.

- Drop the radioactive wastes, stored in canisters, into the seabed folds where the continental plates are sliding under one another. The radioactives would go back into the magma from which they came.

Each of these solutions gets rid of the stuff, but at some expense, and no profit. What the world needs now is another genius. We need a way to turn radioactive wastes into wealth.

And I believe I know the way.

Make coins out of it.

Radioactive money has certain obvious advantages.

A healthy economy depends on money circulating *fast*. Make it radioactive and it will certainly circulate.

Verifying the genuineness of money would become easy. Geiger counters, like pocket calculators before them, would become both tiny and cheap because of mass production. You would hear their rapid clicking at every ticket window. A particle accelerator is too expensive to be practical for a counterfeiter; counterfeiting would become a lost art.

The economy would be boosted in a number of ways. Lead would become extremely valuable. Even the collection plates in a church would have to be made of lead (or gold). Bank vaults would have to be lead lined, and the coins would have to be separated by dampers. Styles of clothing would be affected. Every purse, and one pocket in every pair of pants, would need to be shielded in lead. Even so, the concept of "money burning a hole in your pocket" would take on an entirely new meaning.

Gold might still be the mark of wealth. Gold blocks radiation as easily as lead. It would be used to shield the wealthy from their money.

The profession of tax collector would carry its own well-deserved penalty. So would certain other professions. An Arab oil sheik would still grow obscenely rich, but at least we could count on his spending it as fast as it comes in, lest it go up in a fireball. A crooked politician would have to take bribes by credit card, making it easier to convict him. A bank robber would be conspicuous, staggering up to the teller's window in his heavy, lead-shielded clothing. The successful pickpocket would also stand out in a crowd—a thick, lead-lined glove would be a dead giveaway, but without it, he could be identified by the condition of his hands. Society might even have to revive an ancient practice, amputating the felon's hand as a therapeutic measure before it kills him.

Foreign aid to Third World countries could be delivered by ICBM.

Is this just another crazy utopian scheme? Or could the American people be brought to accept the radioactive standard as money? Perhaps we could. It's got to be better than watching green paper approach its intrinsic value. The cost of making and printing a dollar bill, which used to be 1.5 cents, is rising inexorably toward $1. (If we could count on its stopping there . . . but it costs the same to print a twenty.)

At least the radioactive money would have intrinsic value. What we have been calling nuclear waste, our descendants may well refer to as fuel. It is dangerous precisely because it undergoes fission, because it delivers power. Unfortunately, the stuff *doesn't* last "thousands of years." In 600 years the expended fuel is no more radioactive than the ore from which it was originally obtained.

Dropping radioactives into the sea is wasteful. We can ensure that they will still be around when the earth's oil and coal and plutonium have been used up, by turning them into money now. ∞